PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Principal Contents

NOVEMBER 1949

		PAGE
51	MATHEMATICS	711
52	ASTRONOMY. ASTRO-PHYSICS. GEODESY	712
53	PHYSICS	717
530.1	Fundamentals	718
531	General mechanics. Mechanics of solids	723
531.7	Mechanical measurements	723
532	Mechanics of fluids	724
532.6	Capillarity	725
532.7	Molecular theory of liquids	726
533	Mechanics of gases	726
533.7	Molecular theory of gases	728
534	Vibrations. Acoustics	728
535	Optics. Radiation. Spectra	733
536	Heat	742
536.7/.8	Thermodynamics	746
537	Electricity	746
537.1	Theory. Electrons	746
537.2	Electrostatics. Dielectrics	747
537.3	Electric conduction. Currents	748
537.52	Electric discharges	751
537.531	X-rays	753
537.533/.534	Cathode rays. Positive rays	754
537.54	Discharge tubes. Counters	757
537.56/.58	Ionization. Thermionics	759
537.591	Cosmic rays	761
538	Magnetism	763
538.3/.5	Electromagnetism. Electrodynamics	765
538.6	Magnetic effects	766
539.11	Theory of solid state	766
539.13	Molecular structure	766
539.15	Atomic structure. Isotopes	768
539.16	Radioactivity. α-, β- and γ-rays	770
539.17	Nuclear reactions	774
539.18	Atom and molecule beams. Mesons. Neutrons	776
539.2	Structure of solids	778
539.3/.8	Elasticity. Strength. Rheology	778
541	PHYSICAL CHEMISTRY	782
541.121/.123	Phase equilibrium	782
541.124/.128	Reaction kinetics	782
541.13	Electrochemistry	783
541.18/.182	Colloids. Disperse systems	784
541.183	Adsorption	785
541.2	Atomic theory	787
541.4/.6	Chemical structure	787
543/545	Chemical analysis	788
548	CRYSTALLOGRAPHY	789
548.7	Molecular and X-ray crystallography	790
55	GEOPHYSICS	793
551.5	Atmosphere. Meteorology	795
57/59	BIOLOGY	799
61	Medical science Human physiology	799
666	Glass. Ceramics	802
669	Metallurgy	802
77	PHOTOGRAPHY	802

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

MATHEMATICS 51

517 : 518.5 : 621.3

50. Applications of mathematics to electrical engineering. KRON, A.-W. *FIAT Rev. German Sci.* 1939–1946) [*Off. Mil. Govt. Germany*] "*Appl. Math.*, V," 63–79 (1939) *In German.*—A review, with complete bibliography, of developments in: (1) conformal mapping; (2) matrix calculus, applied to circuit problems; (3) oscillations, including harmonic synthesis and analysis; (4) eigenvalue problems; (5) operator calculus, including Laplace transforms; (6) electrical instruments for performing various mathematical operations. L. S. G.

517.512.4 : 621.392.26 : 621.396.611.4

51. Some Bessel equations and their application to wide and cavity theory. KLINE, M. *J. Math. Phys.*, 37–48 (*April*, 1948).—The existence of roots of the equation given in Abstr. 5186 (1949) is established for values of k near zero. It is shown that as $k \to 0$ these roots approach roots of $J_n(x) = 0$ and $J_n'(x) = 0$, respectively. This result is applied in several ways to the theory of waveguides and cavities. L. S. G. (R)

517.564.3

52. Recurrence relations for cross-products of Bessel functions. GOODWIN, E. T. *Quart. J. Mech. Appl. Math.*, **2**, 72–4 (*March*, 1949).—The relations are useful in the computation of the cross products, which occur in scattering problems and electromagnetic problems. L. S. G.

517.6

53. Asymptotic expansions of Coulomb wave functions. ABRAMOWITZ, M. *Quart. Appl. Math.*, **7**, 83–84 (*April*, 1949).—The functions occur in nuclear collision problems, and satisfy a certain second order differential equation. Methods for calculating the regular solutions of this equation are presented. L. S. G.

517.942

54. On certain asymptotic solutions of Riccati's differential equation. OLSSON, H. *Ark. Mat.*, **1** (*paper* 3) 21–5 (1949) *In English.*—The solutions, which are useful in certain types of problems involving the Schrödinger wave equation, are obtained by means of the W.B.K. method. Conditions are found in order that the series obtained by this method, when it diverges, is an asymptotic solution. L. S. G.

517.942

55. Relaxation oscillations. LASALLE, J. *Quart. Appl. Math.*, **7**, 1–19 (*April*, 1949).—The oscillations are governed by the equation

$$d^2x/dt^2 + \mu f(x)dx/dt + x = 0$$

and the regions $E(\mu)$ of the phase plane each of which contains a single periodic solution, are explicitly constructed. A simple physical example, relating to an RC-circuit, with R non-linear and non-passive, is considered in detail. The regions $E(\mu)$ are constructed and the uniqueness of the periodic solution in each region is proved. Methods are given for computing bounds on periods and amplitudes and their asymptotic values. L. S. G.

517.942.9

5856. Homogeneous harmonic functions. PORITSKY, H. *Quart. Appl. Math.*, **6**, 379–88 (*Jan.*, 1949).—Solutions of Laplace's equation, $\phi_{xx} + \phi_{yy} + \phi_{zz} = 0$, such that $\phi(C_x, C_y, C_z) = C^n\phi(x, y, z)$, for any constant value of C are investigated. The two cases, $n = 0$ and $n = 1$ are treated at length on account of important applications to "conical" flows. G. G.

517.944

5857. Integration, by the operational calculus, of the equation of a spherical wave of attenuation or pressure. CALDIROLA, P. AND SILLANO, P. *Acta. Pont. Acad. Sci.*, **10** (*No.* 21) 229–44 (1946) *In Italian.*—The equation, $\partial^2u/\partial t^2 - \Delta u - ku = X$, is solved by a Laplace transform method. Application is made to the equation of the retarded potential, and to the meson equation. L. S. G.

517.948

5858. On a class of singular integral equations occurring in physics. THIELMAN, H. P. *Quart. Appl. Math.*, **6**, 443–8 (*Jan.*, 1949).—It is shown that for a certain class of Wiener–Hopf integral equations, which occur in problems in electrodynamics, a direct method yielding the explicit solution is available. The method is simpler than that using Fourier transforms. L. S. G.

518.12

5859. Coefficients for facilitating trigonometric interpolation. SALZER, H. E. *J. Math. Phys.*, **27**, 274–7 (*Jan.*, 1949).—The Lagrangian form of the trigonometric interpolation formula is quoted. The coeffs. are simplified. An expression A^{2n+1} appearing in the coeffs. is tabulated for the case of equidistant ordinates at interval h. S. M.

518.2

5860. Table of sines and cosines to fifteen decimal places at hundredths of a degree. *Nat. Bur. Stand., Appl. Math. Ser.* (*No.* 5) viii + 95 *pp.* (1949).

518.2

5861. A table of the coefficients of the Hermite quadrature formula. KOPAL, Z. *J. Math. Phys.*, **27**, 259–61 (*Jan.*, 1949).—A formula of Lagrangian type is quoted which approximates to an infinite integral. No estimate of the error is indicated. The points $x_{n,i}$ at which ordinates are to be chosen, and the weighting coefficients $c_{n,i}$ for these ordinates are tabulated. The error is $<$ one unit of the last decimal. S. M.

518.5

5862. A new regression analyser. ORCUTT, G. H. *J. Roy. Statist. Soc., Ser. A*, **111**, 54–70 (1948).—The machine described operates by analogue methods on input data expressed in digital form. The series to be analysed are recorded on punched cards, each series occupying a different card. The basic calculations of regression analysis are performed by electrical methods, each digital series being converted to a time varying voltage. M. R.

518.5 : 531.55

Mechanical solution of problems in external ballistics. *See Abstr.* 5974

518.5 : 621.318.572 : 621.317.39

5863. A large-scale general-purpose electric analog computer. HARDER, E. L. AND MCCANN, G. D. *Trans. Amer. Inst. Elect. Engrs*, **67**, 664–73 (1948).—Description of two versatile analogue computers (at Westinghouse and C.I.T.) in which a steady-state or transient electrical forcing function, generated electronically or by synchronous switches, operates on a circuit analogue of the differential equation of an electrical or mechanical system, and the output is measured or observed on a c.r.t., with an accuracy 1–5%. The importance of shielding is emphasized and a list of possible engineering applications is given. A. O. S. (R)

518.5 : 621.318.572

5864. The IBM pluggable sequence relay calculator. ECKERT, W. J. *Math. Tables Aids Comput.*, **3**, 149–61 (*July*, 1948).—The machine reads numbers from punched cards, performs calculations by relay networks, and punches the results on to cards. 6-digit multiplications are performed in 0·15 sec. There are 36 storage and computing registers, and cards can be read and punched at the rate of 100/min. The reading and recording speed is greater than that of any other calculator. Division is performed by successive subtraction, and square roots derived by the successive addition of odd numbers to the complement of the number. Parallel operation is possible. The multiplication of matrices and harmonic series, the reduction of observational data, the solution of differential equations and the construction of mathematical tables are discussed as illustrations. A. J. K. (R)

518.5 : 621.318.

5865. A comparison of various computing machi used in the reduction of Doppler observati STIBITZ, G. R. *Math. Tables Aids Comput.*, **3**, 373 (*Jan.*, 1949).—In a "radio-Doppler" method determining the co-ordinates of the trajectories long-range rockets, signals are sent from a transmi to the rocket and to several ground stations. rocket frequency-doubles the signals and retransm The receivers also frequency-double the orig signal and mix this with that from the rocket. mixed signals are recorded on a film. The pa deals with the 3-receiver problem. Data from any receiver prescribe that the missile is on the surface a prolate spheroid, one focus at the transmitter one at the receiver. The actual location is the comm intersection of 3 such spheroids possessing a comm focus. There are two solutions, one of which is va ~ 40 mathematical operations are required to de mine one point. The application to this problem computors available in the U.S.A. is discussed. A. J.

519 : 541

5866. Use of statistical inequalities in polyn research. HERDAN, G. *Research, Lond.*, **2**, 23 (*May*, 1949).—An extension, to the case of fractio order moments, of the method described by author in a letter to *Nature* [**163**, 139 (*Jan.* 22, 1949) N. L

519.4 : 530.

5867. On problems involving permutation degenera CORSON, E. M. Letter in *Phys. Rev.*, **75**, 126 (*April* 15, 1949).—The irreducible representations the symmetric group S_n for a system of n electr can be obtained by a process involving only element algebra. It is an induction process from S_{n-2} to S_n G. J.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521

5868. Mathematical methods of astronomy. SCHÜTTE, K. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Appl. Math., Pt V*," 101–19 (1949) *In German.*—References are given to books, monographs and numerical tables produced during the war. Subjects discussed include: (1) determination of the orbits of planets and comets; (2) stellar statistics, space distribution and the motion of stars; (3) determination of the orbits of double stars; (4) dynamics of star systems, and theory of the rotation of the galaxy; (5) theory of planetary atmospheres and comets; (6) theory of the structure of stars; (7) interstellar matter, and the theory of the sun. L. S. G.

521.1 : 551.594.5

Application of the methods of celestial mechanics and Störmer's problem. *See Abstr.* 6618

521.13 : 530.12

The problem of three bodies treated in the general theory of relativity. *See Abstr.* 5932

521.2

5869. Vectorial derivation of the laws of central motion. RUBBERT, F. K. *Astr. Nachr.*, **276**, 127–9 (*June*, 1948) *In German.*—Using vector geometry w complex notation it is shown that the laws of cent motion and a number of correlated theorems can derived in a particularly simple and physica significant way. A

52

5870. New theory of the major planets of the so system. ROURE, H. *Bull. Astr., Paris*, **15** (*No.* 1–74 (1949) *In French.*—First two parts of a comp hensive new planetary theory, partly stimulated the lunar theory of Hill and Brown. As advanta over previous theories by Laplace, Leverrier, H Newcomb and Gyldén are stated: From the fi approximation onwards the method embodies powers of the masses; all secular terms can eliminated; tables of ephemeries can readily be c structed giving immediately the positions tak account of the perturbations. If it is required include the effect of a second, third, etc., body, principle the same equations can be used as for first disturbing planet, with only their second te changed. The whole calculation is more uniform a simplified. The first part of the entire work dea as a first approximation, with the perturbed pla

sumed to lie in the ecliptic, and then considers in rther steps the terms depending on the first and gher powers of the eccentricities and inclinations. the second part the rectangular and polar co-dinates are developed, allowing also for the latitude the disturbing planet. A. B.

521.5

871. New theory of the solar planetary system. OURE, H. *C.R. Acad. Sci., Paris*, **223**, 885–7 *Nov.* 27, 1946) *In French.*—The methods of the ill–Brown lunar theory are applied to planetary otion. R. A. N.

522.1

872. The Royal Greenwich Observatory. JONES, . S. *Proc. Roy. Soc. A*, **198**, 141–69 (*Aug.* 15, 949).—An historical survey.

522.3

873. On the free surface of a mercury bath. ARWICK, J. V. *Bull. Astr., Paris*, **14** (*No.* 2) 145–51 949) *In French.*—Mathematical treatment of the ptical properties of the surface to determine what art of it is suitable for applications to positional stronomy. A. B.

522.53 : 535.315

874. On a new double image micrometer, its ossibilities and some related questions. MULLER, P. *ull. Astr., Paris*, **14** (*No.* 4) 257–313 (1949) *In rench.*—This paper is a study of the distortions of ays in double refraction prisms (Rochon, Wollaston nd others). The practical application is discussed nd experiments to verify are described. Some sults of measures on double stars are given with a sumé of the advantages of the adopted procedure. E. G. M.

522.6 : 621.396.822

875. Radio astronomy. BURROWS, C. R. *Electronics*, **22**, 75–9 (*Feb.*, 1949).—A survey of present nowledge. Observation of radio waves from the n and galaxy has provided astronomy with new ources of information. Results obtained so far show at, at $\lambda \sim 1$ cm, the sun radiates as a black-body of mp. $\geqslant 10^6$ deg. Bursts of solar "noise" may ncrease the normal level by 10^4 at metre wavelengths. he higher the freq. of the disturbance, the lower the lar level in which it originates. Correlation with nspots has been obtained. Radio noise appears istributed over the sky according to the galactic ntours, though point sources (some variable) have een discovered where there are no unusual objects.

522.615 : 523.821.5

876. A comparison of the "constant-deflection" ethod of photoelectric photometry with "electron-ounting" methods. JOHNSON, H. L. *Publ. Astr. Soc. acific*, **61**, 85–7 (*April*, 1949).—The theoretical robable errors of the two methods are found to be lated $\varepsilon_{\text{const. def.}} = \sqrt{(\pi)}\varepsilon_{\text{count}}$. The larger value f $\varepsilon_{\text{const. def.}}$ is due to the inefficiency of an *RC* circuit s an integrator, and it is suggested that a constant-eflection photometer with a pen recorder and small me constant ($\sim 1/50$ observation time) would give sults comparable with electron-counting techniques. M. W. O.

523.11 : 523.2

5877. Cosmical zero, and the origin of radiation and dense matter. STANLEY-JONES, D. Letter in *Nature, Lond.*, **164**, 279–80 (*Aug.* 13, 1949).—It is claimed that Haldane's application of kinematical relativity [Abstr. 1655 (1945)] to provide a theory of the origin of the solar system is inconsistent with the laws of entropy. R. A. N.

523.112 : 530.12

5878. Review of cosmology. BONDI, H. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 1) 104–20 (1948).—The natures of cosmological theory and observational evidence are discussed in some detail, and, in relation to this discussion, a critical examination is made of the cosmologies of kinematical and general relativity. R. A. N.

523.165 : 523.854

5879. Positions of three discrete sources of galactic radio-frequency radiation. BOLTON, J. G., STANLEY, G. J. AND SLEE, O. B. Letter in *Nature, Lond.*, **164**, 101–2 (*July* 16, 1949).—The positions, measured at rising or setting of the source by an interference method, were determined with accuracies of $\pm$ 30–60 sec of time in R.A., $\pm$ 10 min in declination. Within this experimental error each position agreed with that of a nebulous object. One of these was the Crab nebula, and possible temps. for this nebula are discussed. It is suggested that the other two nebulae, N.G.C. 5128 and N.G.C. 4486, classed as extragalactic but unresolved, may be in reality galactic nebulae, and may be identified as the sources of the galactic noise. M. W. O.

523.2

5880. The origin of the solar system. JEFFREYS, H. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 1) 94–103 (1948).—Theoretical developments over the last two decades are reviewed, attention being drawn to important advances, and to various difficulties such as those arising from the high initial temps. of planets and from planetary angular momentum and composition. Lyttleton's fissional theories are discussed in detail. R. A. N.

523.2

5881. On C. F. v. Weizsäcker's hypothesis concerning the origin of the planetary system. NÖLKE, F. *Z. Astrophys.*, **25** (*Nos* 1–2) 58–69 (1948) *In German.*—Discusses von Weizsäcker's theory that the planets were formed from a disc nebula in which turbulence had set up a vortex system. It is maintained that the vortex system could not establish itself. Detailed criticism is also given of the subsequent processes leading to planet formation. R. A. N.

523.2

5882. Remarks on the preceding work of F. Nölke. v. WEIZSÄCKER, C. F. *Z. Astrophys.*, **25** (*Nos* 1–2) 70–1 (1948) *In German.*—[See preceding Abstr.]. Nölke's criticisms are rejected as being concerned merely with very special interpretations of the theory. R. A. N.

523.41/42

5883. Photometry and colorimetry of the planets Mercury and Venus. DANJON, A. *Bull. Astr., Paris*, **14** (*No.* 4) 315–44 (1949) *In French.*—Gives results of many observations of the magnitudes and colours of

the planets Mercury and Venus between 1937 and 1948 at several French stations. The apparatus and method used is described. 8 bright stars of spectral types *B* to *M* were used as intermediary comparisons between the sun and the two planets. The colour indices and the visual and photographic albedos of the planets are derived together with the light curves at various phase angles at constant distance. A bibliography is appended. E. G. M.

523.44

5884. Exact positions of minor planets from photographic observations in Simeis in 1940–41. NEUJMIN, G. N. AND NEUJMINA-ABRAMOVA, M. N. *Bull. Cent. Obs. Poulkovo*, **17** (*No.* 6) 23 (1948) *In Russian. English summary in Astron. News Letter* [*Harvard*] *No.* 43.

523.5

5885. On meteor speed measurements by the radio Doppler method at low frequencies. CHERRY, D. D. AND SHYMAN, C. S. Letter in *Phys. Rev.*, **75**, 1441–2 (*May* 1, 1949).—A direct-inking pen magnetic oscillograph is used to record the pitch of the Doppler interference whistles of 20 meteors on 30·66 and 12·8625 Mc/s. The meteor velocities deduced from the rate of change of pitch is sensibly the same at both frequencies, showing that the rate of growth of the ion column does not influence the pitch even at the lower frequency. The mean velocity of those meteors belonging to the Geminid shower was in good agreement with the results of photographic and radar measures on the same shower. M. W. O.

523.51

5886. On the calculation of planet temperatures from the composition of meteoric matter. KLOTZ, I. M. *Science*, **109**, 248–51 (*March* 11, 1949).

523.51

5887. The composition of meteoritic matter and the origin of meteorites. BROWN, H. *Science*, **109**, 251–4 (*March* 11, 1949).

523.51 : 545.8

5888. The neutron-pile as a tool in quantitative analysis; the gallium and palladium content of iron meteorites. BROWN, H. AND GOLDBERG, E. *Science*, **109**, 347–53 (*April* 8, 1949).—Various elements in meteorites in the concentration range 0·01 to 500 parts/million can be estimated to a few % by measuring the specific activity of samples when irradiated by a known neutron flux ($\sim 10^{12}$ neutrons/cm²/sec). Principles of the method are described, and the physical and chemical procedures for eliminating stray activity are given in detail for the elements Ga and Pd. Results for these elements on 14 Fe meteorites are tabulated. M. W. O.

523.51 : 539.89

5889. Widmannstätten structure in meteoric iron: possible modes of formation under high pressure. VOGEL, R. AND HEUMANN, T. *Nachr. Akad. Wiss. Gottingen* (*No.* 2) 123–5 (1946) *In German.*—The Clausius–Clapeyron theorem permits an estimation of the shift of transformation temps. with rising pressures from available data of specific volumes and transformation energies at normal pressure. Applying this to the pure Fe system extrapolation suggests a triple point at $\sim 15 \times 10^3$ kg/cm² for the δ–γ system. Assuming that essentially this also holds for t Fe–Ni phases involved in the observed *W*-structu of metallic Fe, the δ–γ transformation must be ru out as possible cause of formation at pressu $> 15 \times 10^3$ kg/cm². Similarly the transformation ten of the α–γ system would drop from 900°C to 60 at 5×10^4 kg/cm² (pure Fe) and to 200–400°C Fe–Ni systems. It can be assumed that the tra formation at such temps. would be extremely sl and cease, therefore, altogether at pressu $> 5 \times 10^4$ kg/cm². The above conclusions are int preted as confirming the hypothesis that meteori represent fragments of small cosmic bodies rath than having originated in the Fe–Ni core of large on J. H. O.

523.72 : 551.521

5890. The graphical calculation of (the intens of) solar radiation at the earth's surface. I–II. OSIDA, *J. Phys. Soc. Japan*, **2**, 143–53 (*Sept.–Oct.*, 1947) *English.*

523.

5891. The origin of solar noise. BRUCE, C. E. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*R L/T*204) (1948) 8 *pp.*—Suggests that the electrical d charge theory of astrophysical phenomena outlined an earlier publication [Abstr. 1039 (1949)] offers explanation for both the steady background "nois received from the sun in the short-wave radio banc and for the sudden outbursts which occur duri disturbed solar conditions. Some terrestrial magne storms may be the direct effect of the "atmospheric radiated from solar atmospheric electrical discharg in which the currents which must flow are estimat to be $\sim 10^{14}$ A. The theory would account for t change in polarity observed in many magnetic storm and for the high temps. of the sources of solar noises

523.

5892. The significance of the observation of inten radio-frequency emission from the sun. RYLE, M *Proc. Phys. Soc., Lond. A*, **62**, 483–91 (*Aug* 1949).—A summarizing account is given of possib mechanisms which have been proposed to accou for the emission of intense radio waves from the su Whilst most authors agree that the radiation fro the undisturbed sun is due to an electron temp. 10^6 deg K in the solar corona, the greater intensi emitted from sunspots has led some authors to propo non-thermal mechanisms, based on the cohere oscillation of a large number of electrons in the sol corona above the sunspot. The mechanisms pr posed for the maintenance of coherent oscillations a examined in detail in this paper and it is conclude that whilst they give adequate explanations for t oscillation observed in discharge tubes, no sati factory mechanism has yet been suggested for t maintenance of electron oscillations in the sol corona. It is therefore concluded that the observa tions can only be accounted for by the occurrenc in the solar corona near sunspots, of electron temp of up to 10^{10} deg K. The problem of maintaining a electron temperature of 10^6 deg K in the norma corona, and 10^{10} deg K in the corona near a larg sunspot, has been considered in an earlier pape [Abstr. 1650 (1949)]; it was there shown that by t

ion of the general magnetic field of the sun and the n-uniform rotation of the solar surface, a potential ference is developed between the poles and the ator which is capable of maintaining an adequate ctron temp. in both regions. A.

523.72 : 538.566.2

93. The characteristics of radio-frequency radiation in an ionized gas, with applications to the transfer of radiation in the solar atmosphere. SMERD, S. F. AND WESTFOLD, K. C. *Phil. Mag.*, **40**, 831–48 (*Aug.*, 49).—The function, E, determining the intensity of radiation at any point, is the ratio of the emissivity the product of the absorption coeff. and the square the refractive index. The intensity of "quiet" r.f. ar radiation reaching the earth is expressible in ms of E and the optical depth of the various ray jectories. Formulae are found for the emissivity, absorption coeff., and the refractive index, and nce for E. These formulae are expressed in terms the electron and ion densities and the kinetic np., assuming a Maxwellian velocity distribution. heuristic theory of the absorptive and emissive ocesses is given. L. S. G.

523.746.5

94. The predictability of the probable features of sunspot cycles. GLEISSBERG, W. *Astrophys. J.*, **9**, 321–6 (*March*, 1949).—The author's method bstr. 545 (1943)] to predict with a given probability e features of a sunspot cycle uses the characteristics the 4 preceding cycles. The prediction was successful for the 1947-maximum (the 18th cycle of the rich statistics). The two preceding cycles, Nos. 16 d 17, are now tested and it is concluded that by e application of the probability formulae 7 out of predictable data would have been properly forecast d the method been available at the time. A. B.

523.75 : 537.591.5

Sudden increases of cosmic radiation associated th solar flares. *See Abstr.* 6313

523.77

95. Zeeman effect in astrophysical spectra. RUCE, C. E. R. *Rep. Brit. Elect. Allied Industr. s. Ass.* (*Ref. L/T* 208) 4 *pp.* (1948).—A confirmation the figure given for the current in a solar discharge bstr. 5891 (1949)] is obtained by a calculation of e Zeeman effect expected to be produced by the gnetic field due to the discharge. The calculated oadening of the spectral lines is found to be in good reement with actual measurements. A.

523.77

96. Fraunhofer lines and their center-limb-riation on the solar disc. UNSÖLD, A. *Mem. Soc. tr. Ital.*, **20** (*No.* 1) 49–53 (1949) *In English.*—A ief report is given on recent progress concerning e interpretation of Fraunhofer lines and their riation from the centre to the limb of the solar sc. Atomic theory indicates that most weak lines ould closely follow the scheme "absorption" or cal thermodynamic equilibrium. Strong resonance es mostly broadened by collision damping should hibit noncoherent scattering or "distribution." In e line wings this agrees practically with true bsorption." It is shown that the centre-limb-riation of lines strongly depends on the variation of the Kirchhoff–Planck-function and of the concentration of the absorbing atoms with the depth in the atmosphere. Following Eddington and Barbier a simple method is developed to deal with such problems. Some numerical calculations give good agreement with the measurements of Minnaert, Houtgast, Redman and Adam. The importance of a better knowledge concerning the temperature-distribution in the highest layers of the sun is emphasized. A.

523.77

5897. On the formation of absorption lines by non-coherent scattering. MÜNCH, G. *Astrophys. J.*, **109**, 275–88 (*March*, 1949).—First-order perturbations are applied to Chandrasekhar's solution of the Milne–Eddington problem [Abstr. 17 (1948)]. The theory is applied to the interpretation of the Ca II K-line in the sun's spectrum. By appropriately choosing the parameter determining the width of the frequency distribution of the scattered quanta, theoretical and observed line profiles agree well at the centre of the disc and at a point 97% of the distance towards the limb. A. B.

523.77

5898. The fundamental band of carbon monoxide at 4·7 μ in the solar spectrum. MIGEOTTE, M. V. Letter in *Phys. Rev.*, **75**, 1108–9 (*April* 1, 1949).—The existence of the $C^{12}O^{16}$ band at 4·7 μ [Abstr. 3135 (1948)] is confirmed, but large day-to-day changes in intensity lead to the conclusion that the solar contribution to the band is negligible. M. W. O.

523.832

5899. Proper motions of 3 188 stars in five special Kapteyn areas. DEUTSCH, A. N. AND LANDOVSKY, V. V. *Bull. Cent. Obs. Poulkovo*, **17** (*No.* 6) 58 (1948) *In Russian. English summary in Astron. News Letter* [*Harvard*] *No.* 43.

523.841.9 : 523.854.12 : 535.51

5900. Interstellar polarization, galactic magnetic fields, and ferromagnetism. SPITZER, L., JR. AND TUKEY, J. W. *Science*, **109**, 461–2 (*May* 6, 1949).—The observations of Hiltner [Abstr. 2308, 2309 (1949)] and Hall [Abstr. 2310 (1949)] are supposed due to needle-shaped ferromagnetic particles of dimensions comparable with the wavelength of visible light, orientated by interstellar magnetic fields. The existence of such particles is shown to be consistent with the theory of Oort and van de Hulst [Abstr. 3011 (1947)] on the growth of interstellar grains, while fields of the required order of magnitude ($\sim 10^{-5}$ gauss) have been postulated by Fermi [Abstr. 3291 (1949)] in his theory of cosmic rays. M. W. O.

523.851

5901. Remarks on the hydrodynamical treatment of star systems. MICZAIKA, G. R. *Ast. Nachr.*, **276**, 169–72 (1948) *In German.*—Two definitions of mean free path, according to Chandrasekhar, are discussed. In our galactic system the mean free paths may vary between 10^5 and 10^9 parsecs. In distances of the order of 1% to 10% of the mean free paths, stars experience considerable changes in their kinetic energies. A discussion of the value of the Reynolds number shows that turbulence is to be expected in the central part of most galactic systems, but laminar flow may occur in the outer parts. Since the free

paths are comparable to the dimensions of the system, the concepts of kinetic gas theory are not applicable to stellar systems. The statistical-hydrodynamical equations of motion are reduced to the Navier–Stokes equations. M. R.

523.851 : 531.353

5902. The problem of two bodies of variable mass in which the law of force is attractive and proportional to the distance. Applications to globular clusters. GIALANELLA, L. *Mem. Soc. Astr. Ital.*, **20** (*No.* 2) 93–105 (1949) *In Italian.*—Owing to the tendency of globular clusters to disintegrate and the loss of mass of a single star from energy dissipation, the density of matter in a cluster decreases with time. For a homogeneous globular cluster each star is attracted towards the centre with a force $\propto$ the distance. It is known that the equations of motion of a star in such a cluster are integrable in terms of elementary functions if the density varies inversely as the square of the time. The orbits for this case are shown to be ellipses whose axes have fixed directions in space, but whose lengths increase as the fourth root of the mass decrement. This is taken to imply a tendency for the cluster to disintegrate at the same rate. V. C. A. F.

523.851.2

5903. Proper motions of eight globular clusters. GAMALEY, N. V. *Bull. Cent. Obs. Poulkovo*, **17** (*No.* 6) 27 (1948) *In Russian. English summary in Astron. News Letter* [*Harvard*] *No.* 43.

523.852.32

5904. The shape of spiral nebulae. HEISENBERG, W. AND VON WEIZSÄCKER, C. F. *Z. Phys.*, **125** (*Nos* 4–6) 290–2 (1948) *In German.*—The two-fold character of spiral arms is explained qualitatively in terms of the rotation of an "oblong" gaseous cloud. R. A. N.

523.854.12

5905. The determination of light absorption in the dark clouds by means of proper motions. DEUTSCH, A. N. *Bull. Cent. Obs. Poulkovo*, **17** (*No.* 6) 89 (1948) *In Russian. English summary in Astron. News Letter* [*Harvard*] *No.* 43.

523.855

5906. On the absorption in the spiral nebulae. HOLMBERG, E. *Lunds Univ. Årsskr. Avd. II*, 43 (*No.* 3) (1948) *In English.*—A statistical examination is made of observational data on absorption in cluster and field spiral nebulae, special attention being paid to the dependence of total absorption and integrated colour excess on inclination to the celestial plane. Distances are calculated from apparent diameters and radial velocities, but not from the magnitudes of bright resolved stars, as these appear related to inclination. A theoretical study is made of a model characterized by the properties that both the luminous and the absorbing matter are concentrated in oblate spheroids which have common major axes, luminosity and absorption distribution functions within these spheroids being normal. The results obtained by numerical integrations on the total absorption and colour excess at different inclinations, and the ratio of total to selective absorption, is compared with the observational data. The model is found to be satisfactory. Various models with nuclear condensations of light are found to yield similar results. M. W. O.

523.

5907. Oscillator strengths for the continua of Ca GREEN, L. C. *Astrophys. J.*, **109**, 289–96 (*Marc* 1949).—Calculation of atomic constants needed f quantitative discussion of emission phenomena *Me*-variables, of central intensities, of the ionizatio of interstellar Ca, and of the anomalies in the intensi ratios of interstellar Ca and Na. For the 4*s*–4*p*-*s*, 4*p*-*d*, 3*d*-*p* and 3*d*-*f* continua of Ca II a numb of $df/d\varepsilon$-values are tabulated and physically inte preted; for 4*p*-*d* and 3*d*-*f* they should be correct within a factor of 3. A.

523.87

5908. Presidential address on stellar evolutio HOLBORN, F. M. *J. Brit. Astr. Ass.*, **59**, 1–2 (*Jan.*, 1949).—A review of the theories on stell evolution over the last half century, beginning wi the earliest Russell diagram. The gaps visible there and their partial filling in by later observations a mentioned. Recent advances in our knowledge variable stars and novae are described. An extensi bibliography is appended. E. G. I

523.87

5909. The structure of stellar atmospheres. ROSA, A. *Z. Astrophys.*, **25** (*Nos* 1–2) 1–10 (1948) *German.*—Degree of ionization, gas pressure ar effective molecular weight are calculated as functio of electron pressure and temp. for a gaseous mixtu based on Unsöld's estimate [Abstr. 1990 (1948)] the composition of stellar atmospheres, the numb of H atoms being $\sim 5\,000\times$ the number of metall atoms. R. A. I

523.87

5910. The structure of stellar atmospheres. I UNSÖLD, A. *Z. Astrophys*, **25** (*Nos* 1–2) 11–19 (1948 *In German.*—Entropy is calculated as a function gas pressure and temp. for an atmosphere of H ar He, 15% of the atoms being He. These results a used to derive corresponding values for the adiabat temp. gradient, and to obtain a graphical represent tion of the boundary between radiative and convecti equilibrium. R. A. I

523.87

5911. The structure of stellar atmospheres. II ROSA, A. AND UNSÖLD, A. *Z. Astrophys.*, **25** (*Nos* 1–2 20–7 (1948) *In German.*—The specific heat c_p is ca culated as a function of gas pressure and temp. fo the atmosphere considered in II (see precedin Abstr.). R. A. I

523.87

5912. On diffusion by free electrons in an extende stellar atmosphere. BOUVIER, P. *Arch. Sci.*, **2** (*No.* 87–98 (1949) *In French.*—Chandrasekhar's metho [Abstr. 2723 (1945)] is adapted to the case of anis tropic diffusion in atmospheres of finite curvatur Numerical calculations are made for $\kappa\rho \propto r^{-4}$. R. A. I

523.87

5913. On the observable number of Balmer lines i *B*-, *A*-, and *F*-stars. MICZAIKA, G. *Z. Astrophys.* **25** (*Nos* 1–2) 72–6 (1948) *In German.*—Observation of 28 early-type stars give correlations between th number of Balmer lines detected and spectral typ and absolute magnitude. The quantum number

last visible line is an empirical criterion of electron ssure in stars of a given spectral subtype. D. L. E.

523.877

4. The inner structure of the mass-luminosity ction and the chemical composition of main sequence s. LOHMANN, W. *Z. Astrophys.*, **25** (*Nos* 1–2) 108 (1948) *In German.*—Sets up an empirical ition $M_b = \alpha \log M + \beta$ between bolometric gnitude M_b, mass M and spectral type S, α and β ng functions of S. The result is also expressed a relation between M_b, M and effective temp. A f discussion of chemical composition is based on warzschild's equations for the H–He content of sun [Abstr. 1400 (1947)]. R. A. N.

523.877

5. Convection in rotating stars. BIERMANN, L. *Astrophys.*, **25** (*Nos* 1–2) 135–44 (1948) *In German.* Criticizes Randers' conclusion [Abstr. 2246 (1942)] t convection takes place preferably parallel to the s even for slow rotation. The effect of rotation on excess temp. gradient is considered. It is con- ded that, for slow rotation, the energy flux remains ctically isotropic. R. A. N.

523.877

6. On the chemical composition of some late e stars. FUJITA, Y. *J. Phys. Soc. Japan*, **2**, –11 (*Nov.–Dec.*, 1947) *In English.*—Relative ndances of elements in stellar atmospheres are luced from spectra for Z Andr, α Scor, α Boot, Cor B and δ Ceph. O is preponderant in α Scor, l C in R Cor B. R. A. N.

523.877

7. Continuous absorption by molecules in stellar iospheres. ZAPPA, L. *Mem. Soc. Astr. Ital.*, **19** . 3) 183–93 (1948) *In Italian.*—The possibility of tinuous absorption in the atmospheres of late e stars by diatomic molecules of known spectro- pical data is discussed. The intensity of those orptions is negligible for wavelengths longer than 00 Å for all the molecules considered, save for some lrides like AlH. A.

523.877

8. Hydrogen atmospheres in the absence of rmodynamic equilibrium. I. The populations of upper atomic states. GIOVANELLI, R. G. *Aust. J. . Res. A*, **1**, 275–88 (*Sept.*, 1948).—The transition s to and from the upper atomic states of H are cussed. For temps. such as are found in the solar omosphere the populations in the states $n > 11$ maintained largely by 3-body recombination and lision ionization. The populations of these states thus distributed as if they were in thermodynamic ilibrium with the electrons, even when this is not case. Agreement with eclipse observations is icated. A. B.

523.877

5919. Hydrogen atmospheres in the absence of thermodynamic equilibrium. II. The populations of the lower atomic states. GIOVANELLI, R. G. *Aust. J. Sci. Res. A*, **1**, 289–304 (*Sept.*, 1948).—The populations of the H substates of principal quantum number 1, 2 or 3 are calculated for a range of electron concentrations from 10^8 to 10^{13} per cm^3, and electron temps. from $7{\cdot}5\times10^3$ to $1{\cdot}0\times10^5$ °K, in the presence of radiation from a black body at a temp. of 5×10^3 °K, diluted by a factor of 1, 0·5 or 0. A. B.

523.877

5920. Hydrogen atmospheres in the absence of thermodynamic equilibrium. III. The emission of radiation. GIOVANELLI, R. G. *Aust. J. Sci. Res. A*, **1**, 305–18 (*Sept.*, 1948).—Theories concerning the profile and intensity of spectral lines are extended to lines involving a number of degenerate substates, under conditions where thermodynamic equilibrium does not apply. Much information can be obtained from an effective temp. and the absorption coeff., and these two properties are tabulated for the Lα, Lβ and Hα lines of H. The physical conditions assumed cover electron concentrations from 10^8 to 10^{13} per cm^3, gas temps. from $7{\cdot}5\times10^3$ to $1{\cdot}0\times10^5$ °K, and incident black-body radiation of 5 000°K, diluted by factors 1, 0·5 or 0. A. B.

525.14 : 551.11

5921. On the geometric and static oblateness of the earth derived from the periodic terms of the moon's motion. BERROTH, A. *Geofis. Pura Appl.*, **13**, 65–74 (*Sept.–Oct.*, 1948) *In German.*—Recalculation of Hill's 1891 values of the 9 largest terms in longitude and latitude in Delaunay's theory of the moon, using more recent numerical data. The new values are on the average 7% < Hill's. Improved agreement with the observations is noted. A. B.

525.35

5922. Displacements of the pole derived from the Poulkovo observations of meridian marks. ORLOV, B. A. *Bull. Cent. Obs. Poulkovo*, **17** (*No.* 6) 115 (1948) *In Russian. English summary in Astron. News Letter* (*Harvard*) *No.* 43.

527.6

5923. Notes on astro navigation in Polar regions. ZACCHEO, F. E. *J. Inst. Navig.*, **2**, 180–3 (*April*, 1949). —Radio aids are at present of little or no use over the poles and the use of radar is limited by the large ice packs which obscure coastlines. The need for high accuracy in measurements in these regions is stressed and a method of navigation based on a 2-star fix is described. A rotating template is used to indicate the regions of total darkness, of twilight or of daylight. In daylight the sun and moon may be sighted, but during the 6-week twilight periods astro navigation is impossible. C. A. H.

PHYSICS 53

53.081.6 : 539.15

Magnitudes and energy measurements in atomic sics. *See Abstr.* 6359

53.082.75

5924. A method of improving the response of recording instruments. HALL, F. Letter in *J. Met.*,

6, 160–1 (*April*, 1949).—The poor response, due to time constant, of a measuring element such as a thermocouple can be almost completely corrected by the insertion of a compensating network, e.g. a parallel capacitor-resistor network. The effect of other circuit elements present must be borne in mind and also, in the case of the thermocouple, of changes in time constant due to varying ventilation and to air-density changes. Non-linear systems will require linearizing before a compensating device of this kind is introduced. H. G. M. S.

FUNDAMENTALS 530.1

530.12

5925. Cyclographic considerations of the kinematics of special relativity theory. MÜLLER, H. R. *Monatsh. Math.*, **52**, 337–53 (1948) *In German.*—The "cyclographic" method of representation in descriptive geometry is applied to Minkowski's treatment of special relativity. The Lorentz transformation, time dilation, Fitzgerald contraction and Einstein's velocity addition theorem are discussed with the aid of elaborate geometrical constructions. No new physical results emerge. M. R.

530.12

5926. Relativistic invariant equations which correspond to a definite charge and energy. GELFAND, I. M. AND YAGLOM, A. M. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 4) 371–4 (1948) *In Russian.*—[See Abstr. 3590 (1948), 35 (1941)]. An investigation of wave fields described by a function ψ having infinitely many components; in particular, of the question, when charge and energy may be definite, and when not, even for invariant equations of ∞ many dimensions. An analogue of the Pauli theorem for the general non-separable relativistic invariant equations is given, as well as examples of equations corresponded to by definite charge and definite energy, the simplest of which are two equations, for which the function ψ is transformed according to the irreducible representation of the characteristic (and complete) Lorentz group determined by the pair $(0, \frac{1}{2})$ or $(\frac{1}{2}, 0)$, respectively. According to previous results, these equations are the only ones for which ψ is transformed according to the irreducible representation of the characteristic Lorentz group. The corresponding Fourier expansions for total charge and total energy clearly show the definite character of the two quantities, under the usual assumption of a 3-dimensional spatial periodicity of ψ. B. F. K.

530.12

5927. Coefficient of inertia (mass) and motion. SIVADJIAN, J. *Arch. Sci.*, **2** (*No.* 1) 60–86 (1949) *In French.*—A continuation of previous work [Abstr. 508 (1949)]. A detailed historical account is given of the notion of mass and of the connection between mass and motion. Two types of mass (*mass pesante* and *mass inerte*) are distinguished, and if these are identified the principle of equivalence, in general relativity theory, establishes a relation between energy and mass. L. S. G.

530

5928. On the construction of energy-momen tensors depending on spinors. VAN ISACKER, *Bull. Acad. Roy. Belge Cl. Sci.*, **35** (*No.* 4) 45 (1949) *In French.*—A symmetric energy-momen tensor and an angular momentum tensor are c structed for a spinor field described by a Lagrang containing the spinor and its derivatives to order. G. J

530

5929. Scalar densities and laws of conservati ORTIZ, R. *An. Real. Soc. Esp. Fis. y Quím.*, 327–38 (*May–June*, 1948) *In Spanish.*—It is sh that the variational derivative of a scalar den function of an arbitrary covariant tensor of rank t and its derivatives, in a space without metric or c nection, satisfies a certain equation. Eddingt theorem on the vanishing divergence of the variatio derivative of a fundamental scalar density is a spe case of this. It is deduced that this derivative l zero divergence for an infinite set of affine c nections. With certain restrictions, specifying torsion and geodesics of the space together with vanishing of the divergence of a given variatio derivative uniquely determines the affine connecti s.

530

5930. Analysis of the Lorentz group with algebr representation. KAR, S. C. *Bull. Calcutta Math. S* **40**, 163–72 (*Dec.*, 1948) *In German.*—A theorem Einstein, that the group of real Lorentz transfor tions can be resolved into 2 commutative grou each of which is the complex conjugate of the oth is proved with the use of the algebraic representati A representation by means of the Pauli matrices considered. L. S.

530

5931. Wave equations in the de Sitter spa WATANABE, S. *Phys. Rev.*, **76**, 296–7 (*July* 15, 1949). The second-order wave equation $\partial^2 u/\partial x_i \partial x^i = 0$ 5-dimensional flat space can reproduce approximat the field hitherto considered in 4-dimensional spa if a de Sitter space with the radius R is imbedded the 5-dimensional flat space and the derivative of t wave function u in the direction normal to t de Sitter space is assumed to be equal to imu, whe m is a constant proper to the field. Conversely, t ordinary field equations in 4-dimensional space c be regarded as valid only for a portion of de Sitt space with the linear dimension, which is small co pared with the radius R of the universe. Extensio of these arguments to electromagnetic field and spin field are also considered.

530.12 : 521.

5932. The problem of three bodies in the cases Lagrange and Euler, treated in the general theory relativity. GARCÍA, G. *Summa Brasil. Math. I* (194 (*No.* 9) 197–205 (1948) *In Spanish.*—The relativis equations of motion are reduced to equations classical form, using a modified potential, and a approximation of Levi–Civita. The triangul solutions of Lagrange and the collinear solutions c be generalized to the case of this potential. M.

530.12 : 530.145

. The physics of action. A new unitary physics. ovici, A. *Bull. Inst. Polytech. Jassy*, **3**, 543–682 *–Dec.*, 1948) *In French.*—The physics of action new theory which sets out to unify relativistic and ıtum physics; and the principal section of the thesis mathematical account of the theory, based on ract groups and a certain hypercomplex number m which forms the basis for a vector space S_{12}, 2 dimensions. The unity of matter and the ic, of electromagnetism and gravitation, and of and space, is realized in this space S_{12}. L. S. G.

530.12 : 530.145

. The theory of ellipsoidal propagation and its ibilities. I. Relativity, quanta, gravitation. Varlier, H. *Arch. Sci.*, **2** (*No.* 1) 99–114 (1949) *In ch.*—A general historical introduction to a new hematical theory of this type: includes an account s relation to relativity theory. G. J. K.

530.145

5. On the divergence problem in the theory of ntized fields. Rayski, J. *Acta Phys. Polon.*, **9** *s* 2–4) 87–98 (1947–48) *In English.*—The interaction t of the Hamiltonian of the electron plus electro- gnetic field is modified by applying a relativistically ariant integral operator to the current density. ough calculation is made showing that the self- rgy of the electron is thereby made finite. No ussion of Lorentz invariance is given. H. McM.

530.145

6. On the field equations of quantal field theories. ntzel, G. *Z. Naturforsch.*, **3a**, 430–4 (*Aug.–Nov.*, 8) *In German.*—Generalized field equations are nulated in relativistic invariant form. The ting point of the paper is a generalization by nonoga [Abstr. 2949 (1949)] and Koba, Tati and nonoga [Abstr. 2950 (1949)] of a formalism due to ac, Fock and Podolsky [*Phys. Zeits. d. Sowjetunion*, 468 (1932)] in which individual time co-ordinates allotted to different particles. The author's hod for the deduction of Maxwell's equation is rter than that of previous writers due to the ariant character of the formulated field equations. application of the theory to self-energy problems change of field operation due to rest mass nges) is given. H. Mo.

530.145

7. Quantum theory of rest-masses. Born, M. Green, H. S., with Appendices by Cheng, K. C. Rodriguez, A. E. *Proc. Roy. Soc. Edinb. A*, (*Pt* 4) 470–88 (1949).—Current quantum theory ceeds from a set of field equations (for each kind particle) derived from an essentially empirical grangian, having a structure which indicates the a, and containing the rest-mass as an experimentally ermined constant. The object of the present theory o find a general principle which will specify the grangians and rest-masses of all physically possible ticles. For a given spin the Lagrangian is derived, this theory, by using the principle of relativistic ariance and a principle of reciprocity first sug- ted by Born [Abstr. 1852 (1938), 974 (1939)]. It is nd that among the most stable of the predicted ticles with spin zero or unity some have rest-masses agreeing closely with experimentally determined meson masses. Mesons with spin half are predicted. Of particles with rest-mass zero, some have spin unity and may be interpreted as photons, others have spin half and may be interpreted as neutrinos or electrons, in accordance with the modern view that electronic mass is wholly electromagnetic. P. M. D.

530.145

5938. On the general theory of particles of given total spin. Potier, R. *C.R. Acad. Sci., Paris*, **228**, 656–8 (*Feb.* 21, 1949) *In French.*—A total spin operator S^2 is defined, and the most general system of wave-equations determined, which is Lorentz invariant and describes a particle with given total spin S. G. J. K.

530.145

5939. Coherent scattering of radiation and negative energy states. Halpern, O. and Hall, H. Letter in *Phys. Rev.*, **75**, 910–11 (*March* 1, 1949).—The theorem, that expressions for scattering are the same whether or not the negative energy states are occupied, does not hold for coherent scattering, where the initial and final states are the same, or processes leading to bound states. In hole theory matrix elements now appear, with eigenfunctions determined by the combined nuclear and electron potential. Thus hole theory leads to different results than the other. G. J. K.

530.145

5940. The generalised Schrödinger equation in the interaction representation. Matthews, P. T. Letter in *Phys. Rev.*, **75**, 1270 (*April* 15, 1949).—The generalized Schrödinger equation is derived, by a method which gives the required Hamiltonian directly in any particular case. This is true even when the interaction derivatives and therefore the Hamiltonian depend on the direction of the surface. G. J. K.

530.145

5941. On the magnetic moments of the nucleons in meson theory. Luttinger, J. M. Letter in *Phys. Rev.*, **75**, 1277–8 (*April* 15, 1949).—Using a method described earlier [Abstr. 1701 (1949)] the magnetic moments are calculated for vector meson theory using a vector coupling with the nucleons. Tensor coupling gives a divergent result. For neutral theory $\mu_p^{(n)}$ is obtained and $\mu_N^{(n)} = 0$, or with charged theory $\mu_p^{(c)} = 2\mu_p^{(n)}$, $\mu_N^{(c)} = 0$. Owing to the sign of the proton moment in the pseudoscalar theory, obtained earlier, it is possible to obtain correct moments using a mixed theory. Assuming a vector (v) meson mass of 1 000 m and a pseudoscalar (ps) meson mass of 300 m, it is found that the coupling constants should be $g_{ps}^2 \sim 8$, $g_v^2 \sim 8$. Reversing the masses it is found that $g_{ps}^2 \sim 11$, $g_v^2 \sim 6$. G. J. K.

530.145

5942. On the use of canonical transformations for collision problems. Heitler, W. and Ma, S. T. *Phil. Mag.*, **40**, 651–66 (*June*, 1949).—A perturbation theory for collisions between free particles is developed by means of a canonical transformation. In this theory the state of a free particle is redefined by inclusion of its virtual quanta, and the self-energies of all states are included in the definition of the energies. The amplitude of the collision cross-section is given by an integral equation whose kernel is the transformed Hamiltonian. The higher order correc-

tions to the Compton effect are derived and the analogous problem of meson scattering is discussed. L. S. G.

530.145

5943. Equivalence theorems for meson-nucleon couplings. CASE, K. M. *Phys. Rev.*, **76**, 14–17 (*July* 1, 1949).—The equivalence of pseudoscalar and pseudovector couplings of a pseudoscalar meson field with a nucleon field is examined. It is found that to the second order in the coupling constants the two couplings are equivalent except for two terms. One of these extra terms is predominantly an additional self-energy. The other occurs only for charged mesons and modifies the electromagnetic properties of a meson-nucleon system and the scattering of charged mesons. To this order (g^2) it does not contribute to nuclear forces. Similarly, it is shown that the vector coupling of scalar mesons to nucleons can be replaced (to g^2) by a term identical with the last of the above-mentioned terms. These results show that the delta-function interactions which have been found in the past are actually not present. A.

530.145 : 539.185

5944. Theory of the effective range in nuclear scattering. BETHE, H. A. *Phys. Rev.*, **76**, 38–50 (*July* 1, 1949).—The scattering of neutrons up to about 10 or 20 MeV by protons can be described by two parameters, the scattering length at zero energy, a, and the effective range, r_0. A formula expressing the phase shift in terms of a and r_0 is derived; it is identical with one previously derived by Schwinger, but the derivation is very much simpler. Reasons are given why the deviations from the simple formula are very small, as shown by the explicit calculations by Blatt and Jackson. The theory is then applied to proton-proton scattering, with a similarly simple result. Moreover, a method is developed to compare proton-proton and proton-neutron scattering without explicit calculation of a nuclear potential. The most recent experimental results are evaluated on the basis of the theory, and accurate values for the effective ranges are obtained for the triplet scattering of neutrons, and for proton-proton scattering. The nuclear force between two protons is found to differ by a slight amount, but beyond doubt, from that between neutron and proton in the singlet state. All actual results agree with those obtained by Breit and collaborators, and by Blatt and Jackson. A.

530.145

5945. On the two-meson theory. TAKETANI, M., NAKAMURA, S., ONO, K. AND SASAKI, M. *Phys. Rev.*, **76**, 60–3 (*July* 1, 1949).—Main consequences of the two-meson theory by Marshak and Bethe on the one hand and that by Sakata are compared with experiments concerning π- and μ-mesons. It is shown that the pair type interaction between π-mesons and nucleons in "M.B." theory contradicts with frequent occurrence of stars produced by π-mesons, whereas the assumption in Sakata theory that π-mesons with spin 0 or 1 are responsible for nuclear forces does not. Although the smaller range for the nuclear forces thus obtained from the latter theory is not at variance with the high energy neutron-proton scattering experiment, deuteron quadrupole moment cannot be accounted for by a π-meson field alone, so that the admixture of another meson field w larger range is necessitated. Both π-μ-decay μ-nuclear capture can be consistently accounted by assuming spin $\frac{1}{2}$ for μ-mesons as in Sakata the However, nuclear β-decay and μ-β-decay have to considered as direct processes as in Fermi's theor β-decay, instead of indirect processes through vir emission and absorption of π-mesons as assu usually in the meson theory.

530

5946. The interaction representation of the Pr field. BELINFANTE, F. J. *Phys. Rev.*, **76**, 66 (*July* 1, 1949).—The methods used by Schwinge quantum electrodynamics can be generalized in s a way that they become applicable to meson the This is shown by an example. The method u seems slightly simpler than the method proposed the Japanese school. It turns out that the covari field variables in interaction representation are simply the transformed of the covariant varia used in Heisenberg representation. Also it turns to be necessary to confine the space-like surfaces u in many applications to flat surfaces perpendicula the time direction. The direct interaction betw two particles through the meson field is obtained a canonical transformation similar to the 1 approximation Schwinger transformation in quant electrodynamics. The example of a neutral vec meson field discussed in the present paper has b chosen in such a way as to show the analogy quantum electrodynamics. The interaction ene between particles obtained by Schwinger's relativi treatment in meson theory (and also obtainable the other usual perturbation methods) goes over i the Møller interaction for vanishing meson mass.

530.

5947. On a generalization of the lambda-limit process and the non-uniqueness in the removal divergence difficulties in the quantum theory of mentary particles. POMERANCHUK, I. *Phys. Rev.*, 298–300 (*July* 15, 1949).—A generalized process of λ-limiting type is established, leading to the eliminat of the divergences in the integrals of both the class and quantum field theories. As a result, however, process is not unique, and by a suitable choice of convergence factor the observable quantities, s as the proper mass, may be given any finite va This indicates either that limiting processes are capable of solving the basic difficulties in the the of fundamental particles, or that the necessity additional postulates of the nature of selection rules

530.145 : 51

On problems involving permutation degenera *See Abstr.* 5867

530.145 : 530

5948. Relativistic formulation of the quantum the of radiation. MA, S. T. Letter in *Phys. Rev.*, **75**, (*Feb.* 1, 1949).—A special situation which arises wh the time and longitudinal components of the radiat field are treated on the same footing as the transve components is pointed out. For any number transverse photons, the radiation field cannot be c sidered to be in a pure state, but must be represen by the superposition of an infinite number of sta with equal numbers of temporal and longitudi

ɔtons. These two kinds of photons have energies ɔpposite sign, and thus do not contribute to the al field energy. They are present when the total rgy vanishes. Thus the Hilbert vector repre- ting the state may have infinite length and there- e cannot be normalized. H. MO.

530.145 : 539.152.1

9. On nucleon moments and the neutron-electron raction. CASE, K. M. *Phys. Rev.*, **76**, 1–13 *ly* 1, 1949).—Using the newly developed compu- onal techniques and the covariant formalism, the leon magnetic moments and the neutron-electron raction are calculated. A pseudoscalar meson ory is assumed. Finite and unambiguous results obtained to the lowest non-vanishing order in the ɹpling constants. These depend on the unknown ngth of the meson coupling. While a not un- sonable value may be used to fit the proton ment, the corresponding neutron moment comes much too large. With this fitting, the neutron- ɔtron potential turns out to be attractive with an ivalent well depth of the order of 5 to 10 kV. A.

530.145 : 539.18

0. Interaction of mesons with nucleons and light ticles. LEE, T. D., ROSENBLUTH, M. AND YANG, N. Letter in *Phys. Rev.*, **75**, 905 (*March* 1, 1949).— e β-decay of nucleons and of μ-mesons, and the raction of nucleons and μ-mesons all require ɹpling constants of the same order of magnitude. G. J. K.

530.145 : 539.18

1. On the difficulty of the meson theory of lear forces. ARAKI, G. Letter in *Phys. Rev.*, **75**, 01 (*April* 1, 1949).—The interaction between leons and a pseudoscalar meson field, which has n often disregarded in non-relativistic approx., es an interaction energy between nucleons $= -(2M/\mu)^2(f^2/r)e^{-\chi r} - \rho_2^{(1)}\rho_2^{(2)}$ where $\rho_2^{(i)}$ is Dirac matrix for nucleon 1. In the non-relativistic prox. this transforms into the usual central force, l tensor force with r^{-3} term at large distances. This culation shows that the divergence at the origin is rious. G. J. K.

530.145 : 539.18

2. On the vector and pseudovector theories of lear forces. ARAKI, G. Letter in *Phys. Rev.*, **75**, 2 (*April* 15, 1949).—Potentials of the form $+ B\sigma^{(1)} \cdot \sigma^{(2)} + C(M/\mu)^2\rho_2^{(1)}\rho_2^{(2)}]e^{-\chi r}/r$ are ob- ned from these theories, instead of the usual forms, the method used in the pseudoscalar case [pre- ɹling Abstr.]. (M/μ) = (Nucleon mass)/(meson ss). At large distances the last term leads to the term of the usual non-relativistic treatment, but s is not obtained for short distances. Instead there nly a r^{-1} singularity at the origin. G. J. K.

530.145 : 539.18

3. Divergences in field theory. CASE, K. M. tter in *Phys. Rev.*, **75**, 1440–1 (*May* 1, 1949).— normalization of charge and of both meson and cleon masses is not sufficient to remove the ergences in the vector meson theory as it is in ctromagnetic theory. The anomalous magnetic ments of neutron and proton in particular are l divergent. G. J. K.

530.145 : 539.18

5954. Calculation of the self-energy of particles: meson with spin zero. MCCONNELL, J. *Nature, Lond.*, **164**, 218–19 (*Aug.* 6, 1949).—Mass renormalization terms due to electromagnetic interaction have been obtained using the covariant formulation of Kanesawa and Tomonaga, and of Schwinger. The unambiguous term diverges logarithmically. The term corresponding to a quadratic divergence in the earlier theory becomes ambiguous and can be given any value (including zero). G. J. K.

530.145 : 539.18

5955. Calculation of self-energy of particles: particles with spin one. HEITLER, W. AND MCCONNELL, J. *Nature, Lond.*, **164**, 219–20 (*Aug.* 6, 1949).—The covariant formulation with electromagnetic interaction of vector mesons gives two terms, one diverging logarithmically. The other is ambiguous [see preceding Abstr.] but since it does not transform correctly as a mass renormalization term, it seems necessary to assume that it is zero. A regularization procedure applied to the ambiguous integrals would achieve the same result. G. J. K.

530.145 : 539.181

5956. Some mathematical methods in the theory of particle scattering. II. TAMM, I. E. *J. Exp. Theor. Phys., USSR*, **19**, 74–7 (*Jan.*, 1949) *In Russian.*— Some shortcomings of the variational method of determining eigenfunctions of the continuous spectrum are pointed out, in continuation of the first part of the paper [Abstr. 2983 (1949)] and an improved variational method is suggested. B. F. K.

530.145 : 539.185

5957. Scattering of high energy neutrons by protons with non-central interaction. HSU, K. N. AND HU, T. M. Letter in *Phys. Rev.*, **75**, 987–8 (*March* 15, 1949).—Calculations were carried out with Yukawa- and exponential-well shapes of potential, for a neutron energy of 83 MeV. Angular distributions according to symmetrical and charged meson theories are shown for the 2 potentials, curves for a spherical (i.e. "square") well [Abstr. 3599 (1948)] being added for comparison. Agreement with expt. [Abstr. 2741 (1949)] appears to be best for a Yukawa well with symmetrical interaction. The experimental total cross-section is much < that calculated by any of the theories. Use of different ranges for central, tensor and singlet interactions is suggested as a way out of the difficulty. A. P. F.

530.145 : 539.185

5958. On the interpretation of neutron–proton scattering data by the Schwinger variational method. BLATT, J. M. AND JACKSON, J. D. *Phys. Rev.*, **76**, 18–37 (*July* 1, 1949).—Variational methods developed by Schwinger are applied to neutron-proton scattering at energies below 10 MeV. *S*-wave scattering alone is considered, and the tensor force is not taken into account. An expansion is obtained for the phase shift in powers of the energy. The coefficients can be evaluated explicitly from the wave function. The first term of the series is related to Fermi's scattering length, the second term involves an "effective range." The third and higher terms turn out to be negligible. The results are used to define an "intrinsic range" for a potential well of arbitrary shape. Thus a reasonable

comparison of potential wells of different shapes is made possible. The relation between intrinsic range and effective range is discussed. The experimental data on coherent and incoherent neutron-proton scattering are discussed in terms of a "shape-independent" approximation. The best value for the effective range in the triplet state is $r_t = (1{\cdot}56 \pm 0{\cdot}13) \times 10^{-13}$ cm. The effective range in the singlet state is not well determined by the present data. The effect of higher, shape-dependent terms in the expansion of the phase shift is considered. These terms become more important as the well shape becomes more long tailed, but they are found to be negligible within experimental uncertainties for the four well-shapes considered here (square, Gaussian, exponential, and Yukawa). The results for the scattering phase shifts can be extrapolated to negative energy to give an approximate algebraic equation for the energy of the bound state of the deuteron. All the numerical results are shown in graphical form; interpolation formulae are provided where higher accuracy may be needed. A.

530.145 : 541.124

The quantum mechanics of chemical kinetics of homogeneous gas phase reactions. *See Abstr.* 6486–7

530.145.1

5959. Relativistic equations of motion of free dipole and quadrupole particles. Średniawa, B. *Acta Phys. Polon.*, **9** (*Nos* 2–4) 99–108 (1947–48) *In English.*—An extension of the work of Mathisson [Abstr. 969 (1938); 2582 (1940)]. H. McM.

530.145.6

5960. On the motion of a vector meson in a homogeneous magnetic field. Symonds, N. *Phil. Mag.*, **40**, 636–44 (*June*, 1949).—Exact wave functions are found, using the Kemmer equation. Two methods are given. The first involves the use of a special co-ordinate system, and this reduces the number of matrices occurring in the Kemmer equation to 3. A representation is then possible in which these 3 matrices are reducible. The second method depends on some properties of the Kemmer matrices due to Schrödinger [Abstr. 1289, 1866 (1943)], and leads to a new form for the second order Kemmer equation in the presence of an electromagnetic field. L. S. G.

530.145.6

5961. On the uniqueness of the potential in a Schrödinger equation for a given asymptotic phase. Levinson, N. *K. Danske Vidensk. Selsk. Mat-fys. Medd.*, **25** (*No.* 9) 29 *pp.* (1949) *In English.*—Conditions are found, on the potential $P(x)$, in order that it be uniquely determinable from the asymptotic phase. The results are proved for the equation, $y'' + \{\lambda^2 - P(x)\}y = 0$, and extended to the equation, $y'' + \{\lambda^2 - l(l+1)/x^2 - P(x)\}y = 0$. For the latter, the potential is uniquely determined from the phase, if $l(l+1)/x^2 + P(x) \geqslant 0$. L. S. G.

530.145.6 : 535.14

5962. On the part played by scalar and longitudinal photons in ordinary electromagnetic fields. Belinfante, F. J. *Phys. Rev.*, **76**, 226–33 (*July* 15, 1949).—When electromagnetic interactions are calculated directly by second-order perturbation calculus without preceding separation of the Coulomb field from the transverse photon field by a canonical transformatio it is fundamentally not allowed to take a state witho photons as zero-order approximation. A mo correct zero-order approximation is determined, which scalar and longitudinal photons are present pairs. The probability distribution over the numbe of pairs present is given by a Schrödinger function these numbers are not limited. No transverse photo are present. The relativistic invariance of such zero-order approximation is proved. This zero-ord approximation is then used for the calculation of t self-energy of a free electron at rest, of the Møl matrix element for electron-electron scattering and the Breit interaction energy between electrons in atom. Apart from mathematical ambiguities in t derivation of the self-energy, this leads to the sa result as can also be obtained by the usual separati of the Coulomb field from the transverse phot field.

530.145.6 : 537.

5963. On the wave-mechanical equations of t electron. Bureau, F. *Bull. Acad. Roy. Belge. C Sci.*, **35** (*No.* 2) 104–42 (1949) *In French.*—T problem considered in an elementary way is the for of a system of equations $a_{ij}^k(\partial u_j/\partial x_k) = \phi_i(x_n$ linear in the 1st-order derivatives of n functions u of an hyperbolic type, representing isotropic wa propagation with a constant speed. The ext condition of Lorentz invariance then leads to t electromagnetic or Dirac equations according to t representation. G. J.

530.145.6 : 537.533.

5964. The variational method for the continuo wave function of an electron in the field of a neutr atom. Huang, S. Letter in *Phys. Rev.*, **75**, 980 (*April* 15, 1949).—The variation principle formulate by Hulthen [Abstr. 492 (1945)] is generalized for th case. For S-scattering by a neutral H atom it expressed in a different form more convenient fo calculation. This form reduces to that of Tam [Abstr. 2983 (1949)] for a special form of the tri wave-function. G. J. I

530.145.6

5965. Enumeration of potentials for which on particle Schroedinger equations are separable. Eisenhart, L. P. *Phys. Rev.*, **74**, 87–9 (*July* 1, 1948).—The 10 possible separable types derived previous [*Phys. Rev.*, **45**, 427 (1934)] are listed here, togethe with the canonical co-ordinates in terms of cartesia co-ordinates, and the corresponding possible expre sions for the potential in cartesian co-ordinates i each case. G. J. F

530.145.6

5966. On the analytical behaviour of the Schrödinge wave-functions. Touschek, B. *Z. Phys.*, **125** (*No* 4–6) 293–7 (1948) *In German.*—A one-dimensiona scattering problem is used to exemplify the genera question of the relation between the continuity of th wave-function with energy or other parameters, an the catastrophic changes in the physical quantitie calculated from it. The conclusion is that branch points in the S-matrix for certain energy values ar associated with a change in the physical process. G. J. K

530.145.63

7. On the approximation of geometrical optics the wave mechanics of a particle of spin $h/4\pi$ resented by Dirac's wave equation. PETIAU, G. *n. Phys. Paris* (*Sér.* 12) **4**, 218–46 (*March–April*, 9) *In French.*—It is shown that, in this approxima-n, the trajectories of a neutrino or electrino in an tromagnetic field may, owing to their very small ss, differ greatly from the trajectories predicted by ativistic mechanics. P. M. D.

530.145.63 : 537.122

8. The acceleration of the Dirac electron. UB, A. H. *Univ. Wash. Publ. Math.*, **2** (*No.* 3) -4 (1940).—Relations between the tensors associated h the Dirac equations are obtained. The 2-nponent spinor formalism of Veblen is used. The eleration of the electron in the direction of the ocity is calculated in terms of these tensors; and relativistic equations of motion are also derived. M. R.

GENERAL MECHANICS MECHANICS OF SOLIDS 531

531.19

9. On the relation between the theory of mixtures l classical statistics. YVON, J. *C.R. Acad. Sci., ris*, **223**, 347–9 (*Aug.* 19, 1946) *In French.*—A real obability function, which is quite unique, is derived the method given by Wigner [*Phys. Rev.*, **40**, 749 32)] for deriving mean values in quantum chanics by methods similar to those used in ssical mechanics. There is no other analogous ction. G. J. K.

531.19 : 536.7

10. Boltzmann's equation for mixtures. KIVELIO-CH, M. *C.R. Acad. Sci., Paris*, **223**, 375–6 (*Aug.* 1946) *In French.*—In a previous paper [*ibid.*, **222**, 73 (1946)] the author considered a single gas and tained a solution for non-stable states by successive proximations. The method is here extended to gas xtures. F. E. H.

531.19 : 536.71

11. Statistical thermodynamics of critical and face phenomena. ONO, S. *Mem. Fac. Engng ushu Univ.*, **10** (*No.* 4) 196–255 (1947) *In English.*—llowing a suggestion of Eyring [Abstr. 2303 36)] the statistical theory of liquids is developed assuming a liquid to be an alloy of molecules and les. Curves are deduced for the liquid and vapour nsities as functions of temp. as well as values for critical temps. of non-polar substances. Good reement with experiment is claimed. The theory is ended to surface layers by the use of the Bragg–lliams approximation for order-disorder transitions. e surface tension and surface energy and their np. dependence are calculated and shown to be in reement with experiment; a law of corresponding tes is deduced for surface quantities. Becker's mula for free energy, introduced in his theory garding phase change in binary alloys, is discussed d an improvement suggested. F. E. H.

531.31

12. The characteristic functions and the equations dynamics. TATEVSKY, V. M. *Vestn. Moskov. Univ.* (*No.* 5) 83–105 (1947) *In Russian.*—The general equations are considered in terms of the variable systems $(\dot{p}_i, p_i)$ and $(\dot{q}_i, p_i)$. The analogues of the various forms of equations are expressed in the new variables. The theory of small oscillations in the variables $p, \dot{p}$ is developed in complete parallel to its familiar form. The exposition is elementary and detailed. M. R.

531.353 : 523.851

The problem of two bodies of variable mass. *See Abstr.* 5902

531.355

5973. Frictional relaxation oscillations. DUDLEY, B. R. AND SWIFT, H. W. *Phil. Mag.*, **40**, 849–61 (*Aug.*, 1949).—Stick-slip phenomena are briefly described. A graphical method is used to solve the equation of motion for oscillations in cases where the intrinsic coeff. of friction varies with the speed of rubbing. The solution is in the form of a curve relating the displacement to the speed of vibration. It is shown that under certain frictional and velocity conditions stick-slip oscillations of a definite form will develop and persist, under others oscillations will decay. Generally slow tractive speeds lead to stick-slip oscillations and these increase in amplitude with the speed. But at a certain critical speed, stick-slip becomes unstable and the oscillations die out, leaving a steady displacement related to the friction intrinsic to the tractive speed. Under certain conditions "quasi-sinusoidal" oscillations, not symmetrical about the position of static equilibrium, may occur at tractive speeds intermediate between stick-slip and decay. L. S. G.

531.55 : 518.5

5974. Mechanical solution of problems in external ballistics. CURTI, P. AND DUBOIS, F. *Schweiz. Bauztg.*, **67**, 52–4 (*Jan.* 15, 1949) *In German.*—Description of an integraph enabling mathematically accurate and rapid calculations of ballistic trajectories, developed by the military section of the Federal Technical College at Zurich.

531.561

5975. Aerodynamic symmetry of projectiles. MAPLE, C. G. AND SYNGE, J. L. *Quart. Appl. Math.*, **6**, 345–66 (*Jan.*, 1949).—The functional dependence of the aerodynamic force system on the instantaneous motion of a projectile is developed in respect of the symmetry of the projectile. The particular cases are considered in which the projectile exhibits rotational and reflectional symmetry such as is the case for a finned projectile. A force system consisting of a vector force and a vector couple is taken. Ultimately these are expanded as power series. Stability criteria are derived for special cases involving axial and cross spins and low orders of symmetry. G. O. B.

MECHANICAL MEASUREMENTS 531.7

531.717

5976. A review of methods for coating-thickness determination. BENNETT, R. S. *J. Sci. Instrum. Phys. Ind.*, **26**, 209–16 (*June*, 1949).

531.768 : 621.317.39

5977. Instrument for measurement of angular accelerations. WEISS, D. E. *Prod. Engng*, **20**, 86–9 (*Feb.*, 1949).—All accelerations of a body may be measured either by translational accelerometers, or by a combination of translational and angular accelerometers. The latter consist essentially of a balanced beam torsionally suspended with one degree of freedom. An iron core inside the beam moves relative to two fixed coils according to the angular acceleration of the beam. One of these coils is supplied with alternating voltage of ~ 2 kc/s. The other coil is split to form two arms of a bridge in which a galvanometer can be suitably calibrated to read angular acceleration. A suitable theory is developed for the purpose of calibration, and mention is also made of accelerometer applications. M.-V. (R)

531.768 : 541.126

Power of explosives determined by ballistic mortar. *See Abstr.* 6489

531.787

5978. A "free manometer" technique for use with the Warburg apparatus. GOLDSTEIN, A. *Proc. Amer. Acad. Arts Sci.*, **77**, 235–53 (*June*, 1949).

531.787

5979. A pressure controller sensitive to 10^{-4} mm of mercury. NISBET, J. S. *J. Sci. Instrum. Phys. Ind.*, **26**, 271–3 (*Aug.*, 1949).—The apparatus maintains constant pressure in a box through which air is flowing. The accuracy of control is within 10^{-4} mm pressure of Hg and the stability within 10^{-4} mm pressure of Hg/hr. The airflow may vary between 0 and 1 800 l/min with the present model. A sealed-bell balanced-beam type of pressure unit is used, arranged to vary the illumination of a photocell. The amplified output from the photocell is used to control the air supply. A.

MECHANICS OF FLUIDS 532

532.12

5980. Compressibility effects in two-phase flow. TANGREN, R. F., DODGE, C. H. AND SEIFERT, H. S. *J. Appl. Phys.*, **20**, 637–45 (*July*, 1949).—A gas-water mixture, when expanded through a de Laval nozzle, acts as a compressible fluid. A general expression for the flow process in an idealized mixture is developed. The general thermohydrodynamic relations for flow through a de Laval nozzle are developed. The magnitude of the velocity of an energy pulse or signal through the mixture is determined and is compared with the velocity of flow. Experimental results are compared with those predicted using the equations developed. A.

532.133.14

5981. Viscosity of deuterium oxide and water from 5° to 125°C. HARDY, R. C. AND COTTINGTON, R. L. Letter in *J. Chem. Phys.*, **17**, 509–10 (*May*, 1949).—Viscosity values for 100-mol % D_2O obtained by linear extrapolation of measurements on 99·5-mol % with respect to D content material, and for ordinary water, are briefly reported and tabulated. For 5–95°C a Bingham variable pressure viscometer, a for 90–125°C an Ostwald type viscometer of spec design, both calibrated by water, were used. T density of the D_2O sample for 90–125°C was al determined, and the extrapolated values for 100-m % D_2O are tabulated. S.

532.

5982. Determination of the density of UF_6 from t sinking temperatures of glass floats. HODGE, H. AND WECHSLER, M. T. *J. Chem. Phys.*, **17**, 617– (*July*, 1949).—By observing the temps. at which gla bodies were just equal in density to the liquid, t density of liquid UF_6 was measured along the satur tion curve from the triple point (64·052°C) to 162·59° The density of the liquid at the triple point was fou to be 3·630 g cm^{-3}. Results of an earlier investigati are also reported. They confirm the later data, a lead to a value of 4·87 g cm^{-3} for the density of t solid at 62·5°C.

532.

5983. A note on Hamy's theorem. GHOSH, N. *Bull. Calcutta Math. Soc.*, **40**, 229–30 (*Dec.*, 1948). The theorem is that a heterogeneous liquid rotati in relative equilibrium about an axis cannot have ellipsoidal density-stratification. It is shown th this result is a consequence of the equations of moti and the gravitational equation. L. S.

532.5

5984. Problems of fluid flow through swarms particles and through macromolecules in solutio BRINKMAN, H. C. *Research, Lond.*, **2**, 190–4 (*Apr* 1949).—The equations of hydrodynamics are extend by adding a damping term involving the viscosity, t permeability and the mean rate of flow. Solutions these equations for the flow of a liquid through swarm of particles, neglecting the inertia terms, a discussed. J. E.

532.5

5985. On the backflow of a viscous fluid in a diverg channel. ABRAMOWITZ, M. *J. Math. Phys.*, **28**, 1– (*April*, 1949).—The first problem considered is th of flow from a straight channel, in which Poiseui flow occurs, into a diverging channel, on the assum tion that the fluid enters the diverging chan radially. The conditions required for backflow, a also for the determination of points of detachme are investigated. The method of approxima solution given by Blasius [*Zeit. J. Math. Phys.*, 5 225 (1910)] is then applied to the problem, witho the assumption of radial flow at entry, and is carri out to higher order terms. An improvement over t Blasius solution is obtained by the introduction of special transformation. On the basis of this solutio the behaviour of the fluid near the entrance to t divergent channel and near its boundaries as well backflow conditions are examined, and the resu are compared with those obtained by Blasius. G.

532.516 : 539.5

5986. The fundamental rheological equation for Maxwellian fluid. TYABIN, N. V. Letter in *J. Ex Theor. Phys., USSR*, **19**, 559–60 (*June*, 1949) *Russian*.—The equation of motion of an incompres ible Maxwellian fluid moving in an external potenti force field is derived. It is shown that in stea

dimensional flow a Maxwellian fluid behaves tly as does a simple viscous fluid. Similarity litions are considered; two flows are similar n the 4 dimensionless parameters $R_e = l_0 v_0/\nu$; v_0^2/gl_0; $H_o = v_0 t_0/l_0$; $S = \tau v_0/l_0$ are equal for 2 flows. In these parameters l_0 is a representative th, v_0 the velocity of the stream, ν the kinematic osity, g gravitational acceleration, t_0 time, and e stress-relaxation period of the fluid. A. SCH.

532.517

. The effect of wire gauze on small disturbances uniform stream. TAYLOR, G. I. AND BATCHELOR, K. *Quart. J. Mech. Appl. Math.*, **2**, 1–29 (*March*, 9).—The gauze imposes a pressure drop and ation in direction on a uniform stream incident n arbitrary angle to the plane of the gauze. The t is determined when the angle is $\frac{1}{2}\pi$ and a small dy disturbance to the longitudinal velocity is osed on the stream. The limitation to a small rbance linearizes the problem and the effect of gauze is to reduce the intensity of the disturbance e leaving its shape unaltered. The effect of the e on turbulence is determined. The intensities uctuations parallel and normal to the plane of the e are reduced by different amounts, and if the ulence is isotropic for upstream from the gauze axially symmetric downstream. The reduction e intensity of turbulent energy is estimated from approx. to the spectrum function in isotropic ulence. L. S. G.

532.517.2

3. On the uniqueness of flows with given stream- S. PRIM, R. C. *J. Math. Phys.*, **28**, 50–3 (*April*, 9).—The question—what flows of the same kind t with the same streamline pattern as the given ?—has been put by Gilbarg and answered by him the case of plane flow patterns [*ibid.*, **26**, 137–42 7)]. The present paper provides the answer for the of 3-dimensional flow patterns. Two theorems established, valid for steady flows of an ideal mpressible fluid in the absence of external force ls: (1) Any flow is unique unless it has a constant city magnitude along each individual streamline; the only steady axially symmetric flows of an scid fluid, in which velocity magnitude, pressure density are constant along each individual stream- are purely axial flows. G. G.

532.517.4

9. The influence of the length of a hot wire on the surements of turbulence. FRENKIEL, F. N. Letter *Phys. Rev.*, **75**, 1263–4 (*April* 15, 1949).—If I_b is factor by which the measured intensity of longi- nal turbulence should be multiplied to give the ect intensity of turbulence then

$$I_b^{-2} = (2/l^2)\int_0^l (l - s)R_y(s)ds$$

re R_y is the transverse correlation coeff. and l is length of the hot wire. The expression for I_b be simplified when l is large compared with the sverse scale of turbulence or when l is small com- d with λ, the microscale of turbulence. A relation so given whereby λ may be derived from measure- its with two parallel hot wires of non-negligible th. A. SCH.

532.517.4 : 532.7

5990. The theory of statistical and isotropic turbulence. CHANDRASEKHAR, S. Letter in *Phys. Rev.*, **75**, 896–7 (*March* 1, 1949).—An explicit solution for the spectral function of turbulence in Heisenberg's theory [Abstr. 469 (1949)] is given for the case of constant S_k. J. E. C.

532.582

5991. Fluid flow patterns. BIRKHOFF, G. AND CAYWOOD, T. E. *J. Appl. Phys.*, **20**, 646–59 (*July*, 1949).—A new photographic technique is described, for observing velocity fields in water, induced by the entry of solid missiles. The results of a number of observations are given, and compared with theoretical formulae. The corrections involved in the method are analysed theoretically, and the theory of the corrections confirmed experimentally. It appears that the method is well adapted to velocity fields 5–100 ft/sec, created by objects several inches or more in diameter, but may lead to troublesome corrections at other speeds or with smaller objects. A.

532.582.3

5992. On the motion of a solid immersed in a fluid. SBRANA, F. *Acta Pont. Acad. Sci.*, **10** (*No.* 26) 297–300 (1946) *In Italian.*—The solid is an ellipsoid of revolution. An expression is given for the acceleration of the solid and it is shown that, under certain conditions, the acceleration may become vanishingly small. L. S. G.

532.585

5993. The formation of closed waves in fluid motions. ALLEN, D. N. DE G. *Quart. J. Mech. Appl. Math.*, **2**, 64–71 (*March*, 1949).—An example of a two-dimensional fluid motion in which the wave boundary is cuspidal is analysed by a method employing a conformal transformation. The fluid flows in a stream of finite breadth, in contact with a fixed boundary, and the direction of flow is turned through a right angle. L. S. G.

532.593

5994. Surface waves. KREISEL, G. *Quart. Appl. Math.*, **7**, 21–44 (*April*, 1949).—Two-dimensional waves, where the crests are straight and parallel, are considered. The reflected and transmitted wave systems for a wave train reaching a cylindrical obstacle, either in the bottom of a canal or fixed in the surface, are determined. Firstly, the asymptotic behaviour of wave motions and the definition of the reflection coeff. are considered. Then it is shown that the calculation of the coeff. is a mixed boundary value problem, whose asymptotic solution must be determined; the problem is reduced to a linear integral equation, which is solved by iteration. The results are used to calculate the reflection coeff. (1) for obstacles in the bottom, and (2) for obstacles in the surface. L. S. G.

CAPILLARITY 532.6

532.66

5995. Flow in a thin glass capillary as affected by wetting the exterior of the capillary. HENNIKER, J. C. AND MCBAIN, J. W. *Science*, **109**, 286–7 (*March* 18, 1949).—There is evidence that the outermost molecular monolayer at the phase boundary of a liquid

induces orientation of molecules lying at some distance from the boundary. Nutting [*Science*, **97**, 74–5 (1943)] claimed that the flow of crude petroleum through a thin walled glass capillary was 6·8% slower when the *outside* of the capillary was surrounded by water. It is now shown that Nutting's results can be explained on the basis of a temp. change. The effect of water is to screen the oil from infrared radiation. If the oil contains a polar long chain compound (0·69% lauryl alcohol added to Nujol) there appears to be a reduction of flow velocity in a series of experiments when the oil is sent repeatedly through a narrow capillary. J. I.

532.613

5996. Relation between surface tension and boundary potential. WAKSMUNDZKI, A. *Ann. Univ. M. Curie-Sklodowska*, **1**, 49–61 (1946).—The ζ–$\Delta\gamma$ curves for 1 : 2 : 3 : 4-tetrahydroquinoline solutions at *p*H 3–10 are not linear, owing to the shape of the molecules being such that the electric field acts tangentially to the surface. This leads to establishment of mutually repulsive forces between the dipoles, which opposes accumulation of molecules at the phase interface. B. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

5997. A statistical theory of liquids. III. JAFFÉ, G. *Phys. Rev.*, **75**, 184–96 (*Jan.* 1, 1949).—Theoretical treatment of heat conduction and viscosity, completing the author's previous work [Abstr. 2157 (1943)]. The result is applied numerically to 10 liquids, using intermolecular potentials previously obtained. L. G. C.

532.712 : 537.36

5998. Osmosis in electrical fields of various frequencies. LÁSZLÓ, Z. Letter in *J. Chem. Phys.*, **17**, 507–9 (*May*, 1949).

532.72

5999. The differential diffusion coefficient of calcium chloride in dilute aqueous solutions at 25°. HARNED, H. S. AND LEVY, A. L. *J. Amer. Chem. Soc.*, **71**, 2781–93 (*Aug.*, 1949).

532.74

6000. Crystallite theory of liquid. I. On the specific heat. OOKAWA, A. *J. Phys. Soc. Japan*, **2**, 108–12 (*Sept.–Oct.*, 1947) *In English.*—After a short review of theories relating to the liquid state, a theory of liquid, based on a solid-like internal structure, showing how variation of specific heat with temp. might be accounted for, is proposed and illustrated by means of a model. An approximate mathematical investigation of the properties of the model is attempted and curves are obtained to illustrate the temp. dependence of the crystallite size and the specific heat. G. G.

532.74

6001. The radial distribution function in liquid argon. ONO, S. *J. Phys. Soc. Japan*, **3**, 167–71 (*March–June*, 1948) *In English.*—This is calculated numerically as a solution of Kirkwood's integral equation, mak use of the approx. as to the coupling paramet [Abstr. 2653 (1935)]. The results agree satisfacto with experimental data. G. J.

532

6002. The energies of vaporisation, viscosity cohesion and the structure of liquids. GRUNBERG, AND NISSAN, A. H. *Trans. Faraday Soc.*, **45**, 125 (*Feb.*, 1949).—For non-polar liquids and for pc unassociated liquids the free energy of visco equals the work of cohesion (W_c), whereas in pc associated liquids the free energy of viscosity exce the work of cohesion by an amount which can attributed to the energy of association per bo All such bonds are broken in vaporization a consequently, E_{vap}/E_{visc} gives the statistical value the number of bonds. If polar liquids are associa in the vapour the ratio E_{vap}/W_c indicates the sy metry of the arrangement, but if unassociated in vapour it gives the arrangement of the molecu From the difference between E_{visc} and W_c and dip moment the degree of association has been de mined for water and alcohols. Esters are un sociated and only acetone—and it only partially associated among ketones. W. R.

MECHANICS OF GASES 533

533

6003. Transient flow of gases in sorbents provid uniform capillary networks of molecular dimensi BARRER, R. M. *Trans. Faraday Soc.*, **14**, 358 (*April*, 1949).—The rate of sorption of various ga on a number of dehydrated zeolites, under conditi of constant volume and variable pressure, has b studied. A diffusion theory has been developed explain the results and the true energy of activatio for interstitial diffusion calculated. *E* ranges fr 12 000 cal. mole^{-1} (for Kr) to 2 500 (for H); value depends on the radius of the sorbate molec and also on the radius of the cations Li, Na, K, N Ca and Ba in a series of base exchange mordeni By base exchange the interstitial channels of m denites can be modified so as to produce a numbe new molecular sieve sorbents which might be used separating the inert gases from one another and fr atmospheric gases. S. J.

533

6004. Diffusion of oxygen in potassium chlor KOSKI, W. S. Letter in *J. Chem. Phys.*, **17**, (*June*, 1949).—The diffusion of O in KCl crystals been studied by a new technique: the KCl is expo to neutrons, thereby converting some Cl^{35} to S^{35}, latter as S^{--} ions which on exposure to O oxidized to SO_3. The progress of the oxidat boundary measures the rate of diffusion: the cry is dissolved slowly in ethyl alcohol and the solut tested at intervals for activity (denoting presence SO_4^{--}). The method was successfully applied crystals 0·5 mm long. S. J.

533.5 : 531.

6005. Theory of a thermal micromanometer. C of low pressures. DUNOYER, L. *C.R. Acad. S*

aris, **228**, 372–4 (*Jan.* 31, 1949) *In French.*—A hot ire micromanometer described previously [Abstr.)24 (1949)] is treated mathematically, and con- usions concerning its construction are drawn. ensitivity depends on the radiation characteristics nd temp. coeff. of the filaments. It is possible to ncrease the sensitivity by cooling and a calibration orrection is given. G. W.

533.585 : 541.124.128

Reactions of metals in high vacua. *See Abstr.* 6488

533.6.011

006. Thermally maintained gas-flows [Thermophon.] HEINRICH, G. *Öst. Ingen. Archiv.*, **3** (*No.* 2) 07–18 (1949) *In German.*—A steady gas circulation is aintained between two chambers kept at a known igh and low temp. respectively. Poiseuille flow is ssumed in the tubes connecting the chambers. A mathematical investigation, subject to certain stated ssumptions, is given of the heat transfer across the alls of the tubes and of the temp. distribution in ach tube. The results obtained determine the elations between the mass of gas flowing per second t any cross-section, the temp. distribution, the imensions of the apparatus, and the nature of the as. A numerical example is given. G. G.

533.6.011.5

007. A new equation for the non-stationary shock-ave. CAP, F. Letter in *J. Chem. Phys.*, **17**, 106–7 *Jan.*, 1949).—Attention is directed to the author's aper in *Helvet. Phys. Acta* [Abstr. 3026 (1949)] from hich the more important results are quoted without iscussion; and without accuracy, owing to confusion etween the symbols μ and u. A. SCH.

533.6.011.5

008. The unsteady shock wave. AUGENSTEIN, . W. Letter in *J. Chem. Phys.*, **17**, 429–30 (*April*, 949).—Derivation of result given by Cap [preceding bstr.].

533.6.011.5

009. Transonic flow in a shock tube. WEIMER, D. K., FLETCHER, C. H. AND BLEAKNEY, W. Letter in *. Appl. Phys.*, **20**, 418–19 (*April*, 1949).—When a liaphragm dividing a tube of uniform cross-section nto two parts containing gas at different pressures is uptured, a shock wave is propagated in the gas at the ower pressure. The gas behind the shock wave avels at approx. sonic velocity. Such an arrangement provides a simple means of obtaining a high-elocity gas-stream for investigations in the transonic egion. The device becomes particularly valuable hen combined with interferometric gas-density-easurement. It has been found that the gas flow s very uniform, and is suitable for quantitative easurements. A. SCH.

533.6.011.5

010. On the stability of the supersonic flows past wedge. CARRIER, G. F. *Quart. Appl. Math.*, **6**, 367–78 (*Jan.*, 1949).—Experimental results show two lternative steady flow configurations in wedge flow, ne involving a weaker, the other a stronger shock ttached to the wedge surface. The problem here iscussed is the interaction of a plane acoustic wave and a shock, and the results obtained are used to prove that the flow configurations associated with a supersonic downstream field are stable. G. G.

533.6.011.5

6011. Linearized compressible flow. PORITSKY, H. *Quart. Appl. Math.*, **6**, 389–403 (*Jan.*, 1949).—Solutions representing linearized compressible flow are obtained by solving the equation $\phi_{xx} + \phi_{yy} + \phi_{zz} = M^2\phi_{zz}$, where M is the Mach number of the flow, for $M > 1$. Examples are discussed of conical supersonic flow, and lift decrease near edge of wing is also investigated. [See Abstr. 5856 (1949)]. G. G.

533.6.011.5

6012. Supersonic flow past slender pointed bodies. WARD, G. N. *Quart. J. Mech. Appl. Math.*, **2**, 75–97 (*March*, 1949).—The limiting values of the aerodynamic force coeffs. are determined for bodies of general cross-section, as the thickness $\to 0$. Results are applied to the problem of a body of revolution carrying wings of small aspect ratio, and the interference between the body and the wings is determined. A simple expression for the lift is obtained. L. S. G.

533.6.011.5

6013. Supersonic flow round pointed bodies of revolution. BRODERICK, J. B. *Quart. J. Mech. Appl. Math.*, **2**, 98–120 (*March*, 1949).—The complete equation for isentropic axisymmetrical flow of a gas past bodies of revolution is solved approx. The potential is expanded in powers of t and $\log t$, where t is the thickness ratio of the body; from the result the pressure and drag coefficients are found correct to order t^4. L. S. G.

533.6.011.5

6014. Supersonic flow past a semi-infinite cone. BRODERICK, J. B. *Quart. J. Mech. Appl. Math.*, **2**, 121–8 (*March*, 1949).—An extension of previous work [preceding Abstr.]. It seems impossible to extend the solution generally, but only for the case of axially symmetrical flow past a cone. This extension gives the same approx. value for the pressure coeff. found earlier. L. S. G.

533.6.011.5

6015. Transonic drag of an accelerated body. BIOT, M. A. *Quart. Appl. Math.*, **7**, 101–5 (*April*, 1949).—A two-dimensional symmetric wedge is uniformly accelerated along the x-axis. The problem of determining the pressure distribution along the wedge at a particular instant, t, is solved, formally, and in detail for the case where the wedge reaches the speed of sound. The presence of an acceleration causes a finite drag at the speed of sound in contrast to the infinite value in the steady case. As the value of the acceleration decreases, the drag $\to \infty$, as the inverse fourth root of the acceleration. L. S. G.

533.6.011.5

6016. Supersonic flow over bodies of revolution. LOTKIN, M. *Quart. Appl. Math.*, **7**, 65–74 (*April*, 1949).—The compressible flow about the head of a pointed body is determined. It is assumed that the actual flow is approximated by a perturbation of the conical flow about the tip of the body. The method of characteristics is used. L. S. G.

533.6.011.5 : 534.222.2

6017. Calculation of the curvatures of attached shock-waves. THOMAS, T. Y. *J. Math. Phys.*, **27**, 279–97 (*Jan.*, 1949).—The angle of inclination α of the shock-wave near the apex (total angle 2ω) of a pointed cylindrical obstruction in a plane supersonic gas stream of Mach number M is calculated. A formula is quoted relating the curvature k of the shock-wave to the curvature K of the streamline immediately behind it. Near the apex K is specified by the geometry of the obstacle. Tables are given (based on a ratio of specific heats $\gamma = 1{\cdot}405$) for k/K and ω in terms of α; the pressure- and density-ratios across the shock-wave are also tabulated. Values of M range from $1{\cdot}05$ to $4{\cdot}45$; the corresponding Mach angles cover the range 73° to 15° in approx. uniform 5° steps. The tabular data are also presented graphically.

A. SCH.

533.6.013.22

6018. Study of a statistical theory of homogeneous turbulence. HITOSI, IOI. *J. Phys. Soc. Japan*, **2**, 155–8 (*Nov.–Dec.*, 1947) *In French.*—The statistical theory of turbulence, and in particular the laws governing intensity of turbulence, are developed under the condition that the coeff. of correlation between two components of corresponding velocities at two points chosen arbitrarily remains invariant throughout the field. The theory yields results in agreement with experimental results obtained by Wattendorf [*J. Aero. Sci.*, **3** (*No.* 6) (1938)].

G. G.

533.6.013.3 : 532.517.4

6019. On the two-dimensional steady turbulent flow of a compressible fluid far behind a solid symmetrical body. II. Vorticity transfer theory. KRZYWOBLOCKI, M. Z. *J. Franklin Inst.*, **247**, 137–54 (*Feb.*, 1949).—The solution is given to the same problem, subject to the same restrictions, as that discussed in Part I [Abstr. 2379 (1949)]. By comparing the solutions obtained by the different theories the following results are established: (*a*) Velocity distributions are identical only to first-order terms; (*b*) temperature distributions differ in first-order terms; (*c*) pressure and density distributions are different beginning from the first approximation.

G. G.

533.66

6020. Theory of a loop revolving in air, with observations on the skin-friction. GREGORY, C. C. L. *Quart. J. Mech. Appl. Math.*, **2**, 30–9 (*March*, 1949).—A study is made of the dynamics of a flexible loop, driven by a small pulley at constant speed, when the speed is large enough to cause the loop to become air-borne. This happens when the air-friction is greater than the weight of the loop. The shape and position of the loop are calculated for values of the ratio, 2α, of air-friction to weight. If $\alpha = 1$, theory predicts a point of the loop at which its radius of curvature is zero. If $\frac{1}{2} < \alpha < 1$, the motion is stable and the value of α may be found from a photograph showing the shape of the loop. Experiments were performed, giving values of α which yield a value of the air-friction drag coeff. of the right order of magnitude.

L. S. G.

MOLECULAR THEORY OF GASES 533.7

533.75 : 541.183.

6021. A kinetic theory of adsorption based [illegible] **Legrange forces of restraint in statistical assemblie** FOGES, G. Letter in *Research, Lond.*, **2**, 294 (*June*, 1949).—When it is assumed that gas molecul and the walls of the container are absolutely rig any accumulation of gas molecules near the wa must be explained on the basis of van der Waa forces or chemical bonding, etc. If the walls of t container are not absolutely rigid then collisions molecules with the walls will take a finite time ar thus molecules will tend to remain near the wal longer than in any other place. This will give t appearance of an adsorption effect which, howeve does not involve any forces of attraction but depen only on the forces of inertia and the repellent Legran forces [see Planck, *Allg. Mechanik*, **1**, 87 (1928 generated in collisions at the walls. The effect small but may be significant when the walls a porous and the pore diameters are $\gtrsim$ the avera mean free path of the gas molecules. This theory ma explain some puzzling phenomena observed durir the adsorption of water on silica gel and of gases c charcoal.

J.

VIBRATIONS . ACOUSTICS 534

534.014

6022. A method of equivalent linearization for non linear oscillatory systems with large non-linearit LUDEKE, C. A. *J. Appl. Phys.*, **20**, 694–9 (*July*, 1949).— This paper introduces a method, based partially c existing non-linear theory and partially on exper mental results, for transforming a non-linear oscill tory system into an equivalent linear one, regardle of the amount of non-linearity in the original syster

534.11

6023. A proposed loading of piano strings f improved tone. MILLER, F. *J. Acoust. Soc. Amer* **21**, 318–22 (*July*, 1949).

534.121

6024. Beats and nodal meridians of a loaded bel JONES, A. T. *J. Acoust. Soc. Amer.*, **21**, 315–1 (*July*, 1949).—A small load on a bell usual changes the rapidity of beats and shifts the positio of nodal meridians. A study of the first 3 partia of one bell leads to the following conclusions. If t antinodal meridian nearest the position at which th load is to be applied is associated with the low [higher] pitched of 2 beating components, the additio of the load increases [decreases] the rapidity of th beats, and also shifts the nearest antinodal meridia of the lower component toward the position of t load. Small increases in the load increase the effects.

534.213

6025. Experimental demonstration of a theorem Lord Rayleigh, relative to the production of pla waves. GRUNENWALDT, J. *Ann. Télécommun.*,

93–9 (*June*, 1949) *In French.*—A source of sound (of ulsatance ω) is emitting vibrations inside an infinite ıbe. Rayleigh's theorem states that the sound wave pproximates to a plane wave when the frequency is ower than the lowest natural transverse frequency of he tube. The investigation confirms the validity of his theorem by further theoretical work and by xperiment. In the experimental arrangement a nite length of tube is used, the ends being closed vith acoustic absorbent material, to annul the eflection from the open ends. A. B. W.

534.213.4

6026. The lined tube as an element of acoustic ircuits. MOLLOY, C. T. *J. Acoust. Soc. Amer.*, **21**, 13–18 (*July*, 1949).—Presents a method for calulating the performance of acoustic circuits conaining lined ducts. The diameters of the ducts must e $< \frac{1}{4}$ the wavelength of sound in free air. The ases of long and short ducts are treated. For the atter, equivalent electrical circuits are given, and ome discussion is given concerning the equivalent lectrical circuits for long ducts. A brief list of ormulae applicable to filters employing lined tubes s given. A.

534.23

6027. Sound transmission through multiple structures ontaining flexible blankets. BERANEK, L. L. AND NORK, G. A. *J. Acoust. Soc. Amer.*, **21**, 419–28 (*July*, 1949).—A general theory of sound transnission for normal wave incidence is developed for a tructure containing two impervious layers, an air pace, and two acoustical blankets. Equations for nore simple structures are derived from the general ase by setting some of the parameters equal to zero. A number of design charts are presented giving ttenuation in db *v.* frequency for different structures vith specific acoustic resistivity of the blanket material s a parameter. Experimental results are found to e in good agreement with the theoretical predictions. It is found that panels deviate from mass law behaviour as their thickness is increased. Mass law behaviour is obtained for panels of any thickness when a laminated construction is used to damp out lexural waves. A.

534.232

6028. Generalized solutions of Webster's horn heory. MAWARDI, O. K. *J. Acoust. Soc. Amer.*, **21**, 123–30 (*July*, 1949).—Webster's equation for the approximate formulation of the propagation of sound waves in horns is solved using two methods of approach. The first method considers a transmission line with variable parameters as the electrical analogue of the horn. This approach is specially useful in yielding generalized solutions for horns of finite length. The second method, based on an investigation of the singularities of Webster's differential equation, leads to the discovery of a great number of new families of horns. A.

534.232

6029. A low "*Q*" directional magnetostrictive electroacoustic transducer. CAMP, L. AND WERTZ, F. D. *J. Acoust. Soc. Amer.*, **21**, 382–4 (*July*, 1949).—The description of a lamination design for the magnetostrictive motors of a directional transducer array. The design makes possible the efficient operation of the transducer with a "Q" of 6 under a full water load. Array patterns are presented to show that the laminated motors radiate as plane pistons into the medium. A.

534.232 : 621.395.613

6030. A new moving coil microphone. GRIESE, H. J. *Fernmeldetech. Z.* [*FTZ*] **1**, 227–32 (*Dec.*, 1948) *In German.*—A novel non-directional moving coil microphone (200 Ω resistance) is described in detail. With a 1 : 30 step-up transformer the sensitivity is 6 mV/μbar, noise voltage 5·4 μV and the dynamic range 61 db. Magnetic induction in the gap is approx. 12 000 gauss, and the diaphragm amplitude at 50 c/s with 100 μbar input 4·8 μ only. Theoretical analysis of frequency characteristic and sensitivity is given, also a cross-sectional drawing, frequency response and polar diagram. A. L. (R)

534.232 : 621.395.623.54

6031. Theoretical bases and practical development of an electromagnetic telephone earpiece giving uniform sound pressure and increased efficiency within a prescribed frequency band. JANSSEN, W. *Diss. Eidg. Tech. Hochschule, Zürich* (1948) 54 *pp. In German.*—Relations are established for the sensitivity and quality of a telephone earpiece. Discussion of these relations indicates how the conditions necessary for faithful reproduction can be satisfied. The theory and construction of a new type of earpiece are described. In this a ring-shaped magnet is used and with its polepieces forms a pot magnet with a ring-shaped cavity in which the coil is located. The premagnetization of the membrane, of 2 V-permendur, is compensated by the use of a second magnet system, similar to the first, arranged in opposition on the other side of the membrane. A method of measuring the efficiency of earpieces as a function of frequency is described which takes account of system losses. Experimental results are discussed. A. W. (R)

534.24

6032. Determination of pressure nodes in liquids. GOLDMAN, D. E. AND RINGO, G. R. Letter in *J. Acoust. Soc. Amer.*, **21**, 270 (*May*, 1949).—Water supersaturated with CO_2 was subjected to a moderately intense standing wave field of 60 kc/s, by employing reflection from the free surface. Gas bubbles up to 2 mm in diameter could be held in layers $n \frac{1}{2}$ wavelengths from the surface. It is concluded that in water, bubbles of a diameter small compared to the wavelength are held at the pressure nodes of a standing-wave system in which the nodal planes are horizontal. G. F. H.

534.24 : 534.321.9

6033. Theory of ultrasonic intensity gain due to concave reflectors. GRIFFING, V. AND FOX, F. E. *J. Acoust. Soc. Amer.*, **21**, 348–51 (*July*, 1949).—A concave reflector can be used to concentrate a beam of plane ultrasonic waves in the focal region, where the intensity I_f is $\gg$ the intensity I_i in the plane wave. When the sound wavelength is small compared to the dimensions of the beam and reflector, one can use the well-known Fraunhofer diffraction formulae to calculate the intensity gain, i.e. I_f/I_i. Expressions are derived for the maximum and average intensity

gain in the zero-order image when the ultrasonic beam is circular or rectangular, together with formulae giving the total intensity falling upon circular or rectangular areas of arbitrary dimensions in the focal region. A.

534.24 : 534.321.9

6034. Experimental investigation of ultrasonic intensity gain in water due to concave reflectors. Fox, F. E. and Griffing, V. *J. Acoust. Soc. Amer.*, **21**, 352–9 (*July*, 1949).—Discusses a method of producing high intensity sound waves in liquids. A beam of ultrasonic waves (4·25 Mc/s, 15×12 mm cross-section, acoustic power ≃ 2 watts) was focused with an ordinary watch glass (6·8 cm radius of curvature). The intensity in the focal region is large enough to raise an ultrasonic fountain 10 cm high accompanied by a spray of fog droplets. The distribution of intensity in the focal region was determined by measuring the screening effect of properly placed obstacles. The sound intensity in the focal region and in the plane wave was measured by the radiation pressure on beads of convenient size. The absolute intensity in the plane wave was also calculated from the driving potential and the measured mechanical Q of the crystal, and reasonable agreement was found with the direct measurement. A gain in intensity by a factor of about 70 was measured where simple diffraction theory predicts 74. For the highest voltages used the extrapolated negative peak pressure was 41 atmospheres. No cavitation was observed. A.

534.24 : 534.321.9

6035. Focusing ultrasonic radiators. Willard, G. W. *J. Acoust. Soc. Amer.*, **21**, 360–75 (*July*, 1949).—Piezoelectric ultrasonic radiators made in the form of a thin spherical shell radiate spherical sound waves which comes to a focus at the centre of curvature of the shell, thus enabling the production of much greater ultrasonic intensity in a small locality removed from the radiator than it is possible to obtain directly at the surface of a radiator. It is here shown by ultrasonic light diffraction pictures of the radiated sound field that the sharpness of focus is limited by wave diffraction in the manner well known in astronomical telescopes and may be calculated by optical diffraction formulae. By the same means the radiation efficiency of different areas of the curved surface is explored and the results compared with theory. The variation of efficiency is, of course, due to the variation of the effective elastic and piezoelectric constants of the differently oriented areas. Calculations are made of the radiation efficiency of a quartz radiator, and it is shown that a greatly improved focusing spherical radiator may be obtained by varying the thickness of the radiator to compensate for the varying frequency constant. Further, superior focusing cylindrical radiators may be obtained by special orientation or by thickness shaping or both. A.

534.25 : 534.321.9

6036. Ultrasonic lenses of plastic materials. Sette, D. *J. Acoust. Soc. Amer.*, **21**, 375–81 (*July*, 1949).—The properties of certain plastic substances have been examined with the idea of using them to construct solid lenses for focusing ultrasonic radiation. Some experiments are described which illustrate the advantages offered by such lenses. The use of a plane cylindrical or a plano-spherical lens permits a reduction to $\frac{1}{10}$ or $\frac{1}{100}$ respectively of the energy which must be emitted by a quartz crystal to produce a given intensity of ultrasonic radiation over a given region. A.

534.2

6037. The diffraction of two-dimensional sound pulses incident on an infinite uniform slit in a perfectly reflecting screen. Fox, E. N. *Philos. Trans.* (*No.* 839) 6–32 (*March* 16, 1949).—A theoretical paper in which a method is indicated of using the results of a previous paper [Abstr. 3661 (1948)] to derive without formal difficulty an explicit solution for any two-dimensional pulse problem involving strips or half-planes as obstacles. Numerical results are given for the particular case of a plane pulse incident normally on a slit in a perfectly reflecting screen. The curves of pressure distribution occurring initially in the direct line of the slit are shown. There is no evidence for the pressure in the rear of the slit ever exceeding unity. The calculations show that the flow through the slit rapidly becomes effectively incompressible. The related problem of a regular grating subjected to a plane pulse at normal incidence can be solved without difficulty by the method indicated in the paper. A. B. W.

534.2

6038. The diffraction of a plane wave through a grating. Miles, J. W. *Quart. Appl. Math.*, 7, 45–64 (*April*, 1949).—Waves of sound normally incident on a plane grating are considered. The potentials on each side are written as Fourier expansions in terms of the velocity in the aperture and an integral equation for this velocity is determined. This is solved approximately. The solution is extended to the case of a vertically polarized electromagnetic wave by analogy, and to a horizontally polarized wave by the use of Babinet's principle. The integral equations for an aperture of finite thickness are set up and solved. Curves showing transmission coeff./aperture are drawn. L. S. C.

534.2

6039. Diffraction by rigid disks and rigid squares. Wiener, F. M. Letter in *J. Acoust. Soc. Amer.*, **21**, 39–40 (*Jan.*, 1949).—Describes briefly an experimental investigation of the variation of sound pressure over the surface of a rigid plate (circular or square) in an approximately plane sound wave, as a function of frequency and angle of incidence. The sound pressure was measured by a small probe microphone traversing the surface and related to the sound pressure in the undisturbed incident wave. The experimental results are in fairly good agreement with theoretical computations of Givian and O'Neil and of Muller, for the diffraction effect at the centre of the plane face of obstacles of various shapes. A. B. W.

534.2

6040. On diffraction through a circular aperture. Miles, J. W. Letter in *J. Acoust. Soc. Amer.*, **21**, 140–1 (*March*, 1949).—An approximate treatment employing a variational method, is given, and the results are compared with those obtained by other methods. P. M. D.

534.26

041. Diffraction of sound by a circular disk. ITNER, A. *J. Acoust. Soc. Amer.*, **21**, 331–4 (*July*, 949).—The near and distant diffraction fields of a rcular disc of zero thickness are plotted according an exact theory. The results are compared with e Kirchhoff approximation and recent experimental ıta. A.

534.26

042. The diffraction of sound by rigid disks and gid square plates. WIENER, F. M. *J. Acoust. Soc. ner.*, **21**, 334–47 (*July*, 1949).—A rigid circular ate was exposed to an essentially plane progressive und wave, and the sound pressure p at various ints on the surface measured relative to the free-ld pressure p_0 in the undisturbed incident wave by eans of a small probe microphone. The diffraction ect $|p/p_0|$ was determined as a function of angle incidence over a range of frequencies beginning th "long" wavelengths and extending into the gion where the radius a of the obstacle approxi-ately equals the wavelength. Expressed in custo-ary notation, $\frac{1}{4} < ka < 8$, where k is the wave mber of the incident wave. Data were obtained r angles of incidence $\theta = 0$, 45, 135 and 180°, here θ is measured with respect to the axis of the bstacle. Similar measurements for $\theta = 0$ and 180° re made for a rigid square plate with side $2a$. pproximate contour maps of the quantity $|p/p_0|$ in) have been prepared from the experimental data ortraying the pressure distribution on the surface the plates. The experimental results are compared th computed values of $|p/p_0|$ obtained from an pproximate theory in which an attempt is made to lve the problem in terms of a scattered potential lculated as if the face of the obstacle were sur-unded by an infinite baffle. The agreement is quite od on the "illuminated" side of the plates, i.e. for = 0 and 45° and on the "shadow" side for $\theta = 180°$. e agreement for 135° incidence is generally poor, though the computed values show the trends of the perimental data in many instances. At low fre-uencies the theory gives values which are somewhat o high on the illuminated side and too low on the aded side. The values of $|p/p_0|$ obtained from the act expression of the diffraction of a plane wave a disc of zero thickness and for perpendicular idence are found to be in good agreement with periment and the approximate theory on the uminated side ($\theta = 0$) and they agree reasonably ll on the shaded side ($\theta = 180°$) for $1 \leqslant ka \leqslant 5$. e region near the edge shows discrepancies which e to be expected from the finite thickness of the cular plate (approx. $a/12$). It is concluded that e approximate theory mentioned above is capable predicting the diffraction effect $|p/p_0|$ on the uminated side of the obstacles in the frequency nge covered by this study for the angles of incidence vestigated. On the shadow side the theory can be pected to yield usably approximate answers only r $\theta = 180°$. There are reasonable grounds for the sumption that similar predictions can be made for ints on or "near" the surface of "thin" plane stacles of arbitrary shape and for other acute angles incidence not too close to $\theta = 90°$. A.

534.321.9

6043. Diffraction of supersonics through rectangular slits. MOKHTAR, M. AND SKEHATA, M. *Proc. Math. Phys. Soc. Egypt*, **3**, 1–11 (*May*, 1948) *In English.*—An experimental investigation is carried out in order to find the amount of divergence due to diffraction that a supersonic beam suffers as it emerges from a rectangular slit. Experiments have been conducted in pure air and in O at frequencies ranging from 100 kc/s to 1 000 kc/s and for various widths of the slit. The locations of the emergent principal beam as well as the diffracted beams were determined by a short hot wire anemometer traversing the beam at various distances from the slit. The same anemometer served also to give the intensity distribution across the principal beam and also the ratios of the intensities of the diffracted beams to the main one. The final results for divergence have the advantage of being applicable for correcting the values of the absorption for the divergence of the supersonic beams when used for such purposes. The correction term for the absorption coefficient is given and also the way it should be calculated in the 3 most common methods for absorption determination. A.

534.321.9

6044. On the fine structure of the visibility curves of the stationary ultrasonic waves. NOMOTO, O. *J. Phys. Soc. Japan*, **2**, 1–6 (*Jan.–April*, 1947) *In English.*—A simple interferometer is described for measuring the intensity or testing the uniformity of a stationary ultrasonic wave field. H. J. H. S.

534.321.9

6045. Measurements of ultrasonic absorption in animal tissues and its dependence on frequency. HÜTER, T. *Naturwiss.*, **35** (*No.* 9) 285–7 (1948) *In German.*—Measurements on a number of body tissues show absorption coefficient $\alpha \propto f$ over the range 1 to 4·5 Mc/s. Values of α range from 0·8 to 4·2 cm^{-1} at 4·5 Mc/s, i.e. half value thicknesses of the order of 1 cm. Temp. dependence between 20 and 35°c was found to be quite negligible. F. T. F.

534.321.9 : 541.182.4

6046. Production of acoustic and ultrasonic waves in fluids for industrial purposes. JANOVSKY, W. AND POHLMAN, R. *Z. angew. Phys.*, **1**, 222–8 (*Nov.*, 1948) *In German.*—The development of industrial ultrasonics is briefly described, particularly with reference to the emulsification of liquids. The extreme effectiveness of an ultrasonic "whistle" (based on the well-known Galton whistle), as compared with the more usual magnetostriction method of emulsifying liquids, is clearly demonstrated. H. J. H. S.

534.321.9 : 620.179.16

6047. Tricks with the supersonic reflectoscope. FIRESTONE, F. A. *Non-Destr. Test.*, **7**, 5–19 (*Fall*, 1948).—Various ways are described of using the reflectoscope for finding internal flaws and for measuring wave velocities in metals. By measuring the velocity of longitudinal and shear waves, Poisson's ratio, Young's modulus and the modulus of shear can be determined whilst residual stress, incipient fatigue and grain size near the surface of a metal may be studied by means of surface waves generated by a crystal of appropriate cut and dimensions.

H. J. H. S. (R)

534.6

6048. Harmonic distortion of "écouteurs" and its practical consequences in audiometry. CHAVASSE, P., CAUSSÉ, R. AND LEHMANN, R. *Ann. Télécommun.*, **4**, 156–68 (*May*, 1949) *In French.*—Distortion most frequently considered in electroacoustics, particularly in telephony, is characterized by lack of flatness in the frequency response curve. High-quality *écouteurs* (earpieces) of various types—electrodynamic, piezoelectric and magnetic—have been critically examined from the point of view of harmonic distortion within a frequency range 5 c/s to 10 000 c/s. In order to achieve 1 or 2% accuracy, it was also necessary to eliminate non-linear distortion from the oscillator and amplifiers used in the investigation. Attention is drawn to the application of the experimental results to telephony and audiometry. A. B. W.

534.61

6049. The loudness and loudness matching of short tones. GARNER, W. R. *J. Acoust. Soc. Amer.*, **21**, 398–403 (*July*, 1949).

534.61 : 621.396.615.11

6050. New instruments in acoustic research. BRUEL, P. V. *Bruel and Kjaer Tech. Rev.*, **1**, 8 *pp.* (*Jan.*, 1949) *In English.*—A new electrodynamic high-speed level recorder having writing speeds up to 1 000 db/sec and a new beat-frequency oscillator with regulating compressor are described. It is shown how it is possible using these two instruments to make recordings of frequency responses of microphones, amplifiers, loudspeakers, etc., building-acoustic recordings of sound insulation of walls, and automatic recordings of reverberation curves in halls. M.-V. (R)

534.75 : 612.85

6051. A study of the mechanism of the middle ear. ONCHI, Y. *J. Acoust. Soc. Amer.*, **21**, 404–10 (*July*, 1949).

534.79

6052. Calculation of the acoustic sensation function. SACERDOTE, G. G. *Alta Frequenza*, **18**, 17–23 (*Feb.*, 1949) *In Italian.*—Mathematical investigation suggests that the relation between the apparent loudness S and physical intensity L of a sound is of form $S = A(L + n)^r$ and a relation of this type $\log S = 7{\cdot}35 \log (L + 27) - 10{\cdot}4$ fits experimental results by Fletcher and by Churcher in which the intensity changes which double the loudness sensation are found. Agreement with experiments in which a tenfold increase in the loudness sensation is used is not so good. On applying this law to experimental results on the minimum perceptible loudness increments it is found that the increment is not constant and is given by $\Delta S = \text{constant}/\Delta L^{3\cdot17}$. T. S. E. T.

534.83

6053. Auditory masking of multiple tones by random noise. SCHAFER, T. H. AND GALES, R. S. *J. Acoust. Soc. Amer.*, **21**, 392–8 (*July*, 1949).—1, 2, 4 and 8 simple tones were presented to listeners against a background of thermal noise. The masked thresholds for the single tones and the various combinations were determined, for different spacings of the tones. In the case of 2 tones, the improvement in threshold with respect to a single tone was slight or negligible unless the tones were within one critical band, when the improvement increased as the spacing decrease In the case of 4 or 8 tones all separated by mo than a critical band, the improvement was slig (< 3 db) or negligible, apparently depending on t combination of frequencies.

534.

6054. A comparison of the acoustics of the Ph harmonic Hall, Liverpool, and St. Andrews Grand Ha Glasgow. SOMERVILLE, T. *B.B.C. Quart.*, **4**, 1– (*April*, 1949).—Discusses new methods for assessi the performance of halls which are an advance ov the original reverberation time method devised Sabine. One method is to observe on a c.r.t. t decay of a steady state tone after switching o Another is to inject a short pulse of tone into the ha and observe the echoes. Reflecting surfaces a located by using a spotlight on a highly directio microphone. The results obtained on the two ha using these methods are detailed with graphs reverberation times for full and empty halls a oscillograms showing build-up and decay of pul tones. The general conclusion is that the Ph harmonic Hall of modern fan-shaped design has m such good measured characteristics as the Andrews Hall, which is a rectangular Victorian desig and these results are confirmed by concert pe formances. Interior photos of the two halls a given and the construction is described: reasons a given for the defects observed from the tests. B. B.

534.8

6055. The practical determination of the reverber tion time of a room by the cathode ray oscillogra MOLES, A. *Radio Franç.* (*No.* 2) 4–8 (*Feb.*, 1949) *French.*—A loud-speaker is used as the sound-sou and the output from a microphone is connected the *Y*-plates of a cathode-ray oscillograph. A sl linear time-base is provided by means of an exter potentiometer rotated by a motor. The decay cur is either photographed or, if a persistent tube is use it may be drawn in ink on the face of the tube. T method of evaluating the reverberation time from t decay curve is given and the advantages of t method over other reverberometers are stressed. G. F.

534.8

6056. A limit to the reverberation time. SACERDO G. G. *Alta Frequenza*, **18**, 69–72 (*April*, 1949) *Italian.*—When the reverberation time-frequer curves obtained from tests on several large chamb are plotted on the same graph it is found that t different curves coincide at high frequencies and the high frequency r.t. is independent of the ro size and wall material. This result can be deduc from Knudsen's modification of Sabine's formula include a term to allow for absorption in the tra mitting medium. T. S. E.

534.851 : 681

6057. Pickup placement. BAUER, B. B. *Electroni* **22**, 87 (*June*, 1949).—Information given previou [*ibid.*, **18**, 110–15 (*March*, 1945)] is supplement The three problems of pick-up arm design are: (1) provide the least tracking-error distortion for giv equipment dimensions; (2) to determine the optim off-set angle of the pick-up head where overhang

nderhang is essential; and (3) to find the best ounting position for an existing arm when records f new groove radii are to be used. The previous nalysis is extended to provide the additional required esign equations. H. G. M. S. (R)

OPTICS . RADIATION . SPECTRA 535

535.14 : 530.145.6

Scalar and longitudinal photons in ordinary electromagnetic fields. *See Abstr.* 5962

535.215.4 : 537.312.5

Optical theory of spectral sensitivity of a Cs oxide notocathode. *See Abstr.* 6207–8

535.231.2

6058. Conditions for blackbody radiation of gases. INKELNBURG, W. *J. Opt. Soc. Amer.*, **39**, 185–6 *Feb.*, 1949).—Gives a simple derivation of the formula or the spectral emission of a thermally excited gas. n particular the relationship between the line emission nd the blackbody emission of a gas is dealt with at ngth, and it is shown that blackbody radiation is pproached with increasing thickness of the radiating yer of gas. A. H.

535.24

6059. The effect of the angular aperture of a telehotometer on the telephotometry of collimated and on-collimated beams. MIDDLETON, W. E. K. *J. Opt. oc. Amer.*, **39**, 576–81 (*July*, 1949).—It is shown heoretically that in telephotometry in a foggy tmosphere, large errors may arise from the scattering f light by the fog into the telephotometer. These rors depend both on the angular aperture of the lephotometer and on the half-angle of the cone of ir illuminated by the distant lamp. Some experiental results are given, which show even larger rors than the hypothetical atmospheres chosen for heoretical investigation. A.

535.243

6060. Simple modification of a photometer to ecome automatically recording. SCHUHKNECHT, W. *pectrochim. Acta*, **3** (*Nos* 3–4) 412–19 (1948) *In erman.*—Describes simple modifications to be made a non-recording microphotometer to make it cording. A synchronous motor moves the plate, hile a second synchronous motor drives the corder. A. C. M.

535.243

6061. Systematic errors in photographic spectrohotometry. KAISER, H. *Spectrochim. Acta*, **3** *Vos* 3–4) 278–96 (1948) *In German.*—With the help f a scheme of symbols, in which measured values re differentiated from real values, an equation of ystematic errors is set up. From it can be deduced ow the measured intensity-ratio of 2 lines is affected y curvature of the plate characteristic, differences in late sensitivity and errors in making calibration arks. If the lines are far apart in wavelength, 2 haracteristic curves are needed. Calculation may n this event be avoided by using an Owens calculating oard. A. C. M.

535.245

6062. On the surfaces equally illuminated by a luminous source. SANSONE, G. *Acta Pont. Acad. Sci.*, **9** (*No.* 12) 127–34 (1945) *In Italian.*

535.247.4 : 537.312.5 : 621.383.4

6063. The detection of small luminous fluxes by means of photoconductors, and their optimum dimensions. WLÉRICK, G. *Rev. Sci., Paris*, **86**, 464–8 (*May–June*, 1948) *In French.*—The fluctuations of the photoelectric voltage generated by a cell at equilibrium, are composed of the thermal noise and of an additional component due to the passage of the current. This component is inversely $\propto$ the modulation frequency of the incident light beam. The luminous threshold is $\propto$ (area)$^{-\frac{1}{2}}$ of the photoconductive surface. This also holds if the electric field is introduced. Thin PbS cells, the width of which has been varied within a ratio of 10 : 1, show that the s./n. ratio max. is $\propto$ (width)$^{-\frac{1}{2}}$ of the cell. This law applies to photoconductive and photoemissive type cells alike. There is no optimum area of surface. There is an optimum, yet non-critical, thickness of the sensitive layer. The surface of the photocathode should always be used to the full. If the incident light beam covers only part of the cathode, the non-illuminated rest of the cathode surface will reduce the sensitivity by acting as a source of background noise. The smaller the surface, the better the luminous sensitivity. The size of the sensitive area depends on the s./n. ratio. W. S.

535.31

6064. The general theory of isoplanatism for finite aperture and fields. DI JORIO, M. *J. Opt. Soc. Amer.*, **39**, 305–19 (*April*, 1949).—A generalization of the compound Sine–Herschel condition applying to any object point. The problem requires only that the system has a plane of symmetry. It is treated by the known methods of optical paths. H. H. HOP.

535.317.2 : 535.81

6065. The direct calculation of achromatised and corrected optical systems. GEIGER, E. E. *J. Opt. Soc. Amer.*, **39**, 193–9 (*Feb.*, 1949).—An empirical method of lens design based upon the restrictive assumption that the deviation of a ray is shared equally by the surfaces of a system. An example is given. H. H. HOP.

535.317.25

6066. The resolution of two particles in a bright field by coated microscope objectives. OSTERBERG, H. AND WISSLER, F. C. *J. Opt. Soc. Amer.*, **39**, 558–66 (*July*, 1949).—A theory is presented for determining the diffraction image of two, identical, opaque or transmitting, uniform, individually unresolved particles of finite area located in a uniform, transmitting surround. Numerical calculations are included for the classical Airy type objective, for centre-blocked Airy type objectives and for simplified Sonine type objectives which have been coated so as to produce diffraction patterns having central discs of reduced diameter. It is shown that marked improvement in the resolution of two particles can be expected by such coated objectives. The resolving power for two particles increases rapidly with the area of the particles and has unexpectedly steep dependence upon the

relative amplitude and phase transmission of particle and surround. The theory, subject to experimental verification, forms a basis for explaining why a microscope as used with transmitted light can resolve considerably better than is indicated by the Airy limit. A.

535.317.25

6067. The resolving power of a coated objective. OSTERBERG, H. AND WILKINS, J. E., JR. *J. Opt. Soc. Amer.*, **39**, 553–7 (*July*, 1949).—A theoretical method is described for reducing the diameter of the central bright disc in the diffraction pattern produced by an objective from an unresolved pinhole as object. On the basis of the Airy criterion the limit of resolution is therefore improved. The method offers a systematic approach for discovering how to coat the exit pupil of the objective with light absorbing and refracting materials so as to reduce the diameter of the central bright disc and yet obtain favourable energy distribution in the diffraction rings. The method selects that family of diffraction pattern whose amplitude and phase distribution can be expressed as a series of Sonine diffraction integrals. The coeffs. of this series automatically determine both the characteristics of the diffraction pattern and of the corresponding coating which must be applied to the exit pupil. The numerical results obtained for a simple series involving Bessel functions of the first and second orders are included. In this case the radius of the bright disc is 77% of that of the usual Airy disc when the energy density at the diffraction head is 21% of that of the classical Airy disc. The radius of the central bright disc can be reduced still further at the expense of serious reduction of the energy density at the diffraction head and a corresponding increase in the energy content of the diffraction rings. A.

535.317.4

6068. Tolerance for spherical aberration. MORAIS, C. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 27–66 (*Jan.–Feb.*, 1949) *In Spanish.*—A study of the conditions under which the max. residual errors (for spherical and sphero-chromatic aberration only) of an optical system are within Raleigh's limits. L. P.

535.317.9

6069. An improved Schmidt plate. HAWKINS, D. B. G. *Phil. Mag.*, **40**, 670–9 (*June*, 1949).—The profile of an improved aspheric plate which minimizes the off-axis errors of Schmidt cameras over a given field is obtained. For monochromatic systems the errors are reduced to $\frac{2}{3}$ those of the classical Schmidt, if axial stigmatism is retained; or to $\frac{1}{3}$ if some spherical aberration is introduced into the system. For chromatic systems a method is given of calculating the equation of the profile which minimizes the overall errors for different spectral ranges over given fields. L. S. G.

535.323 : 536.413

6070. Index of refraction and coefficients of expansion of optical glasses at low temperatures. MOLBY, F. A. *J. Opt. Soc. Amer.*, **39**, 600–11 (*July*, 1949).—It is found that the absolute refractive index of any optical glass studied attains a min. value at some temp., and that the min. refractive index is attained at decidedly higher temps. with long wavelengths than with short wavelengths. Absorption bands in th ultraviolet are known to advance toward long wavelengths when an absorbing glass is warme from liquid air temp. Because of its closer proximit the absorption band's advance would be accompanie by a more rapid increase of absolute refractive index in the short wave end than in the long wave end the spectrum, with rising temp. At the same tim expansion decreases the physical density and tends to diminish N with rising temp. At som particular temp. the two effects of temp. change ma cancel each other. At lower temps. than this, th density effect may prevail and N fall with rising temp while at higher temps. than that for min. N, th absorption effect may exceed the density effect, ar the N must rise with rising temp.

535.33 : 534.222.2 : 537.525

Ultra-violet spectra of highly condensed discharg and shock waves. *See Abstr.* 6229

535.33.

6071. A new discharge tube for the hydrogen ato spectrum. VAN OORT, W. P. AND VAN HEEL, C. Letter in *Rev. Sci. Instrum.*, **20**, 319–20 (*April*, 1949).- The tube, which dissipates 400 W (mains freq.) a has a life of at least 500 hr, is filled with water vapo the pressure of which is regulated by using a solutio of NaOH in water. The Al electrodes, necessary f the discharge, clean up some of the O and the resulti "free" H, which is undesirable, is removed by Cu in a side-tube. J. D.

535.33.

6072. Rapid scanning spectrometer for oscill graphic recording. BULLOCK, B. W. AND SILVERMA S. Letter in *J. Opt. Soc. Amer.*, **39**, 200–1 (*Fe* 1949).—Describes a spectrometer employing a P cell and an oscilloscope display. A quartz prism used, with a Littrow mirror, pivoted about the midd and driven by the coil of a moving coil loud-speak at 40 c/s. Scanning time is of the order of 0·005 s A. C.

535.33.

6073. An automatic recording infra-red spectr meter. BROWNLIE, I. A. AND CUMMING, W. Letter in *Nature, Lond.*, **164**, 105–6 (*July* 16, 1949).- An outline of the novel features in design of t instrument is given. W. R.

535.33.

6074. Principles of construction of prism spectr graphs. HANSEN, G. *Spectrochim. Acta*, **3** (*Nos* 3– 397–411 (1948) *In German.*—An investigation of t relative merits of spectrographs incorporating one several prisms, with special reference to 3-pris spectrographs. With several prisms, less material required for the same resolving power, brilliance a linear dispersion than when one large single pris is used. The chief drawback is that the extremes the spectrum are further from the axis of the came and to circumvent this, mechanical movement each prism and the camera is necessary, or t moving of the prisms and a mirror, the camera bei at rest. Various mechanisms for this purpose a described. The mechanism is simpler when the lens and prisms are made from the same material. A. C.

535.33.072

6075. Correction of slit-width errors. HARDY, A. C. AND YOUNG, F. M. *J. Opt. Soc. Amer.*, **39**, 265–70 (*April*, 1949).—Owing to the finite width of the slits, a thermopile or other receptor placed behind the exit slit of a monochromator indicates the integral of the energy over a finite band of wavelengths. The object of the paper is to explore the possibility of providing a spectrophotometer with automatic means for correcting the error. The error may be lessened by using narrow slits, but this entails either low speed of scan or low accuracy, on account of the limited response of the receptor. A formal general mathematical investigation of the error is made. The odd derivatives of the spectral transmittance curve can be eliminated by using a procedure due to Van den Akker [Abstr. 2319 (1943)] for arranging a special wavelength calibration which gives the same transmittance for a filter (whose transmittance is a linear function of wavelength in the region concerned) when a continuous source is used and the slits are normal, as is got when the slits are very narrow and a discontinuous source is used. This can be arranged automatically by having a wavelength cam cut so that this special calibration is introduced. The preferred arrangement is to provide a cam cut as for very narrow slits, and add a second cam (which may be of less accuracy) which provides the corrections for finite slit-width. The second cam may take the form which a straight edge would do, if placed across the top of the slit and inclined correctly. The error is eliminated by the "straight-edge" changing its slope as the effective wavelength changes. Of the even derivatives, the only important one is the second. This is eliminated automatically in the Hardy spectrophotometer by introducing a retarding plate of variable effective thickness (e.g. Babinet compensator) between the Wollaston prism and the rotating Rochon prism. A. C. M.

535.33.072 : 621.385.832

6076. The image orthicon in spectroscopy. BENN, R. E., FOOTE, W. S. AND CHASE, C. T. *J. Opt. Soc. Amer.*, **39**, 529–32 (*July*, 1949).—Use of the image orthicon tube as a detector in spectroscopy provides rapid response at controlled instants and, for short exposure times, greater light sensitivity than the photographic plate. The application of the orthicon spectrograph to the study of transient or rapidly varying light sources is discussed. A.

535.331

6077. A note on the arc spectrum of lithium. EDLÉN, B. AND LIDÉN, K. Letter in *Phys. Rev.*, **75**, 390 (*March* 1, 1949).—The line λ4132, previously reported (from interferometer measurements by Meissner, Mundie and Stelson [Abstr. 1810 (1949)]) as being 4 132·173 Å is found to be 4 132·60 Å, as measured from grating and prism spectrograms. It is suggested that the discrepancy is due to the inaccurate wavelength data available having led to the choice of an incorrect order number in the interpretation of the Fabry–Perot patterns of this line. A. H.

535.331

6078. Erratum: Structure of the ^2D terms of the arc spectrum of lithium. MEISSNER, K. W., MUNDIE, L. G. AND STELSON, P. H. Letter in *Phys. Rev.*, **75**, 891 (*March* 1, 1949).—The authors agree with the correction put forward by Edlén and Lidén (see previous Abstr.) and give the corrected wavelengths for the two components of λ4132 as 4 132·618 Å and 4 132·562 Å. A. H.

535.332

6079. Bands from doubly excited levels of the hydrogen molecule. DIEKE, G. H. *Phys. Rev.*, **76**, 50–7 (*July* 1, 1949).—A band system of H_2 is described which has as upper state $(2p\sigma)^2\,{}^1\Sigma$. Although this state has two electrons excited, its energy is about the same as that of the states with only one electron excited to a two-quantum state. The positions of the lines and their intensities are very irregular. These irregularities, however, can be satisfactorily explained as being due to the interaction with the $(1s\sigma)\,(2s\sigma)\,{}^1\Sigma$ state. A.

535.332

6080. The molecular spectrum of hydrogen. The Fulcher bands of TH and T_2. DIEKE, G. H. AND TOMKINS, F. S. *Phys. Rev.*, **76**, 283–9 (*July* 15, 1949).—The spectra of TH and T_2 were photographed under high dispersion. The analysis of the $3p\,{}^3\Pi \rightarrow 2s\,{}^3\Sigma$ bands of these molecules is presented and the constants of the two states given. A.

535.333

6081. Complex spectra of the diatomic manganese halides. BACHER, J. *Helv. Phys. Acta*, **21** (*No.* 5) 379–402 (1948) *In German.*—Vibrational analyses of an emission band-system of MnF and of absorption systems of MnCl, MnBr and MnI are given. The systems lie in the region 3 000–4 000 Å and arise from $^7\Pi - {}^7\Sigma$ transitions: the multiplet separations in the upper $^7\Pi$ states have been determined. R. F. B.

535.333

6082. New bands of columbium oxide. RAO, V. R. Letter in *Curr. Sci.*, **18**, 168–9 (*May*, 1949).—Red-degraded band systems of CbO λ6500–5600 and λ5600–4200 are obtained in emission from a Cb arc in air and a heavy-current discharge through $CbCl_5$ vapour. A. G. G.

535.338

6083. Relativistic intensities of multipole radiation in the Lyman series. RZEWUSKI, J. *Acta Phys. Polon.*, **9** (*Nos* 2–4) 71–86 (1947–48) *In English.*—All calculations are made on the basis of Dirac's relativistic theory of the electron. Selection rules, Zeeman effect, and sum rules are worked out both in the general case of a central potential and for the Coulomb potential. H. McM.

535.338

6084. Multipolar radiation in atomic spectra. RUBINOWICZ, A. *J. Phys. Radium*, **10**, 33*d*–44*d* (*May*, 1949) *In French.*—A review of recent progress in the study of multipole radiation of atoms, not only as evidenced by optical spectra, but also by short-wave radio and X-ray spectra. A. C. M.

535.338

6085. Selection rules for singlet-triplet perturbations in polyatomic molecules. MCCLURE, D. S. Letter in *J. Chem. Phys.*, **17**, 665–6 (*July*, 1949).—Closer study of the selection rules has verified Shull's conclusion that the triplet-singlet emission band of

benzene has the vibrational structure of a $^1B_{1u} - {}^1A_{1g}$ transition showing that the singlet state is a $^1B_{1u}$ state and the triplet state is $^3B_{2u}$. W. R. A.

535.338.1 : 536.46

6086. On the spectrum of flames containing potassium salts. SINHA, S. P. Letter in *Curr. Sci.*, **18**, 168 (*May*, 1949).—The continuum reported by Panay when KCl is added to a Bunsen flame is not characteristic of K. It is due to increased ionization and is of the electron-radiation type. The NO + O yellow-green continuum may also be present. It is doubtful if lines of the sharp and diffuse series of K are really present. A. G. G.

535.338.1 : 536.46

6087. Combustion studies with the orthicon spectrograph. AGNEW, J. T., FRANKLIN, R. G., BENN, R. E. AND BAZARIAN, A. Letter in *J. Opt. Soc. Amer.*, **39**, 409–10 (*May*, 1949).—The photosensitive surface of an image orthicon is placed in the focal plane of a large-aperture spectrograph; the repeating traces of intensity against wavelength are recorded on a rotating-drum camera. It is suitable for transient spectra. Traces of a heptane explosion flame were taken at millisecond intervals. As the flame temp. rises a band at 0·93 to 0·96 μ develops first (10 m sec) followed by bands in the red and yellow (15 m sec) and green (25 m sec). A. G. G.

535.338.332 : 537.525.5

6088. Some spectral characteristics of the positive column of a sodium vapour lamp. TAWDE, N. R. AND MEHTA, G. K. *J. Univ. Bombay*, **17**, 23–31 (*March*, 1949).—A description is given of the fine structure of the λ5890 and 5 896 Å lines of Na, excited in a low pressure Ne/Na discharge lamp and observed with the aid of a Lummer plate. A line broadening of about 0·06 Å was observed, which was attributed to Doppler effect, with strong evidence of self-absorption. This value of Doppler broadening is equivalent to a temp. of 500°K. J. D. C.

535.338.333 : 539.152.2 : 539.155.2

6089. Hyperfine structure in the spectrum of W_I. KOPFERMANN, H. AND MEYER, D. *Nachr. Wiss. Göttingen* (*No.* 2) 106 (1946) *In German.*—The nuclear spin quantum number for W^{183} is $\frac{1}{2}$, and the nuclear magnetic moment is very small. Values of the isotope splitting, 182–184 and 184–186, are given for two terms, $5d^46s^2(^5D)$ and $5d^46s6p$. R. F. B.

535.338.334

6090. Broadening of the line 2 536·5 Å and formation of quasi-molecules in mercury-molecular gases systems. KUSHNIKOV, YU. A. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **12**, 366–71 (*July–Aug.*, 1948) *In Russian.*—Emission spectrum of Hg in the presence of other gases has been excited in a discharge tube with Al cylindrical electrodes and a quartz window. It has been found that (1) in the case of collisions between excited Hg atoms and molecules, when the process of extinction is weak, one can observe in the line $\lambda = 2\,536{\cdot}5$ Å a broadening of the same type as in instances when the extinction does not inhibit the process, e.g. with inert gases, (2) the decrease of intensity on the long-wave side is equal for admixtures of gases having various dipole moments, and corresponds to the van der Waals forces in accordance with the relationship C/r^6; the bond strength calculated according to London's formula for dispersion forces gives an energy value of 0·18 eV for an excited Hg atom and N_2 molecule (distance 3·5 Å), and (3) the short-wave side of the broadened line the decrease corresponds to that obtained from Lorentz formula for the impact extinction of radiation. F.

535.338.35 : 539.1

6091. Determination of the population of atom levels by the reversal method. PENKIN, N. P. AND SHUKHTIN, A. M. *Izv. Akad. Nauk, SSSR, Ser. Fiz.* **12**, 376–81 (*July–Aug.*, 1948) *In Russian.*—The population of the atomic levels of Cs has been determined by the method of reversing the spectral lines, the experiments being carried out in the tube of the Kirchhoff furnace which ensured isothermic conditions to the low-pressure gas plasma contained in that tube, where the excitation of atoms was of the temp. type. In compliance with theoretical considerations, the electron temp. decreases as pressure and current density increase. No increase of T_e with increase of current intensity has been observed. The difference between the reversal temp. T_r of the second duplet and the electron temp. T_e of the plasma diminishes as the discharge current increases. The ratios of concentrations of atoms in $7p^2P^0_{\frac{1}{2}}$ and $7p^2P^0_{3/2}$ states to concentrations of atoms in the (ground) $6s^2S_{\frac{1}{2}}$ state depend largely upon the vapour pressure. F.

535.338

6092. Band-spectral intensity distributions in electrodeless ring discharge of ultra-short wave. II. Study on OH band. HORIE, T. *J. Phys. Soc. Japan*, **1**, 6 (*July–Dec.*, 1946) *In English.*—The intensities of the rotational lines of the (*O*, *O*) band of the OH radical were measured and anomalies noticed near $J = 25$. D. H.

535.338

6093. Abnormal rotation of the OH molecule. I. WAKESIMA, H. *J. Phys. Soc. Japan*, **2**, 12–14 (*Jan.–April*, 1947) *In German.*—Measurements on the intensity of individual rotation lines of the OH emission spectrum produced by a Geissler discharge in H_2O vapour at various temps. D. H.

535.338

6094. A note on the initial level of the high pressure bands of carbon. TAWDE, N. R., MENON, M. G. AND MEHTA, G. K. *J. Univ. Bombay*, **17**, 32 (*March*, 1949).—A critical discussion of the origin of the h.p. C_2 bands is given, and new data on the intensities, determined as a function of the pressure in a CO-filled discharge tube, of the h.p. λ4680 and the Swan λ5165 bands suggest that they form bands ($v' = 6$) in the Swan system. This is in accordance with a suggestion of Herzberg. The bearing of this work on the dissociation energy of C_2 is discussed. J. D.

535.338.

6095. Fermi resonance in benzene. ASUNDI, R. K. AND PADHYE, M. E. Letter in *Nature, Lond.*, **16** 638 (*April* 23, 1949).—In an analysis of the near ultra emission bands of benzene, an extended series of doublets due to Fermi resonance was found. A. C.

535.338.41

6096. Tests of identification of some transitions in the molecular spectrum of nitrogen. JANIN, J. *C.R. Acad. Sci., Paris*, **223**, 321–2 (*Aug.* 12, 1946) *In French.*—Emission bands of N in the u.v. previously reported by Janin, Herman or Gaydon, and new bands at 2 839 and 2 980 Å, are identified with transitions to the $a^1\Pi$ state of N from highly excited levels obtained by Worley from the absorption spectrum. A. G. G.

535.343.32

6097. Comparative study of the ultra-violet absorption of solutions of potassium nitrate in ordinary and heavy water. DARMOIS, J. *C.R. Acad. Sci., Paris*, **223**, 616–18 (*Oct.* 21, 1946) *In French.*—Solutions of KNO_3 in H_2O (0·01, 0·1, 0·2, 1·0 and 2·0 N) and in D_2O (0·2, 1·0 and 2·0 N) have been examined at 20° in the spectral range 2 600–3 300 Å. Differences in the spectra are discussed and explained. W. R. A.

535.343.32–2

6098. Absorption measurements on neodymium salts in solution. OETJEN, G. W. *Z. Naturforsch.*, **4a**, 7–10 (*April*, 1949) *In German.*—Variation of molecular absorption coefficient with concentration, most marked for the nitrate near 5 780 Å, is attributed to complex formation. D. H. W.

535.343.4

6099. Near ultra-violet absorption spectra of vapors of benzyl halides and several other organic compounds. TAMANISHI, S. AND KANDA, Y. *J. Sci. Res. Inst. Tokyo*, **43**, 199–214 (*June*, 1949) *In English.*—U.v. absorption spectra of gaseous phosgene, benzyl chloride, benzyl cyanide, benzyl bromide, diphosgene, thio-diglycol, dichloro-diethyl-ether and dichloro-diethyl-sulphide (mustard gas) were studied with quartz spectrographs. Taking phosgene as an example some qualitative and quantitative spectro-analytic applications of u.v. absorption bands are discussed. For the 3 benzyl halides discrete-band systems are newly found, and for each of them vibrational analysis is carried out. For the remaining compounds only continuous absorption regions are found. A.

535.343.4

6100. Regularities in the absorption spectrum of naphthalene vapour. PRIKHOTKO, A. F. *J. Exp. Theor. Phys. USSR*, **19**, 487–92 (*June*, 1949) *In Russian.*—Absorption spectra of naphthalene vapour have been photographed and analysed at different temps. and different lengths of the absorption layer. The results have been compared with those obtained by other authors and a new explanation of the spectrum has been given. It has been found that the spectrum is due to 3 purely electronic transitions with different vibrational structure within the naphthalene molecule. F. L.

535.343.4

6101. Transparency of mercury vapours for the mercury resonance line λ2537 Å at small optical densities of the absorption layer. BIBERMAN, L. M. AND GUREVICH, I. M. *J. Exp. Theor. Phys. USSR*, **19**, 507–14 (*June*, 1949) *In Russian.*—The results of measurements have been compared with the results of the theory of diffusion of the resonance radiation. F. L.

535.343.4

6102. The rotation spectrum of water vapour. I–II. NOSAWA, T. AND TOYODA, T. *J. Phys. Soc. Japan*, **2**, 116–32 (*Sept.–Oct.*, 1947) *In English.*—A detailed theoretical treatment in a semi-rigid rotator approximation gives good agreement with experiment. Tables of eigenvalues are given. D. H. W.

535.343.4–14

6103. O^{17} and S^{36} in the rotational spectrum of OCS. LOW, W. AND TOWNES, C. H. Letter in *Phys. Rev.*, **75**, 529–30 (*Feb.* 1, 1948).—The $J_{1\to 2}$ rotational transitions of $O^{16}C^{12}S^{36}$ and $O^{17}C^{12}S^{32}$ were detected with a recording Stark modulation microwave spectrometer with a noise level equivalent to an absorption coeff. of 5×10^{-10} cm^{-1}. The exact frequencies and intensities lead to the weight of S^{36} as 35·97834 ± 0·0004 m.u. and an abundance of 0·0136 ± 0·0010%. The absence of quadrupole fine structure suggests the spin of S^{36} is zero and of O^{17} is ½. D. H. W.

535.343.4–14 : 539.133

6104. Second-order Stark effect of methyl chloride. KARPLUS, R. AND SHARBAUGH, A. H. Letter in *Phys. Rev.*, **75**, 889–90 (*March* 1, 1949).—The theoretical Stark pattern for the rotational transition $J_{0\to1}$, $K_{0\to0}$ of methyl chloride is discussed for the individual lines of the quadrupole fine structure and shown to be in approximate agreement with experiment. The dipole moment observed is 1·70 ± 0·03 *D*. An erratum [*ibid.*, **75**, 1449 (*May* 1, 1949)] gives a corrected value of 1·87 ± 0·03 *D*. D. H. W.

535.343.4–15

6105. Absorption of microwaves in gases. MILLMAN, G. H. AND RAYMOND, R. C. Letter in *J. Appl. Phys.*, **20**, 413 (*April*, 1949).—Absorption coefficients, $\simeq 10^{-3}$ nepers/cm, are given for a number of polar gases at 3·2 cm wavelength and atmospheric pressure. D. H. W.

535.37

6106. Phosphorescence of potassium chloride crystals activated with thallium. ZUK, W. *Ann. Univ. M. Curie-Sklodowska*, **1**, 63–89 (1946).—KCl moistened with aq. $TlNO_3$ is fused, and KCl crystals are grown from the melt. A spark discharge (Al electrodes) excites phosphorescence of the crystals, the intensity rising with increasing [Tl], to a max. at 0·0032 mol.-%, thereafter falling. For the series KCl, NaCl, KBr, NaBr and KI (all 0·01 mol.-% Tl) intensity of luminescence (I) falls in the order given. Increasing duration of excitation over 5 sec, or illuminating the excited phosphors with red light, causes quenching of the luminescence, the effect of red light being most marked during the initial period. The log I–log t curves, where t is time in sec after excitation, consist of 3 branches, of which the third, at $t = 400$, corresponds with a bimolecular recombination reaction. The shape of the curves suggests that the crystals contain 2 zones, A and B, with a time of passage of an electron through zone B of 300–400 sec. The first branch of the curves corresponds with a recombination reaction in zone B. The nature and intensity of luminescence are unaffected by repeated excitation. B. A.

535.37

6107. Practical application of luminous substances.

GOREV, Z. M. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 2) 257–70 (1949) *In Russian.*—Luminescent illuminators based on phosphors of constant action are described for the illumination of the scales of various apparatus such as sextants, binoculars, magnetic compasses, etc. The optimum conditions for using phosphors of transient action such as Zn phosphors are worked out, the results for various phosphors being given in the form of nomograms. Investigation of means of counteracting the combined deleterious effect of moisture and short ultraviolet (254–300 mμ) on ZnS and ZnS . CdS phosphors indicated that of various synthetic resins examined, urea-formaldehyde and polystyrene afforded the greatest moisture protection, while incorporation of 0·25–35% Fe in the optical glass so as to cut out the ultraviolet gave even better results. W. H.

535.37

6108. Zinc sulphide phosphor constitution and its effect on electron traps. GARLICK, G. F. J., WELLS, A. F. AND WILKINS, M. H. F. *J. Chem. Phys.*, **17**, 399–404 (*April*, 1949).—Thermoluminescence curves for ZnS are discussed with reference to various activators, fluxes and heating conditions. Production of long afterglow ("deep traps") is due to a change in the lattice at high temps. as well as to the presence of Cu activator; it seems to be independent of the blende-wurtzite transition at 1 020°C, though the proportion of deep traps increases with firing temp. up to 1 050°C. Some results on thermoluminescence of ZnCdS phosphors, and on the temp. dependence of fluorescence in ZnS . Cu, are briefly described. S. T. H.

535.37 : 545.82

Luminescent analysis of minerals. *See Abstr.* 6536–7

535.371

6109. The effect of activator concentration on the infrared-sensitive phosphor, strontium selenide-samarium, europium. TEXIN, H., WILLIAMS, H. AND WARD, R. *J. Amer. Chem. Soc.*, **71**, 2494–8 (*July*, 1949).

535.372

6110. Remark on the variation with time of the phosphorescence spectrum of neon. HERMAN, L. *C.R. Acad. Sci., Paris*, **223**, 622–3 (*Oct.* 21, 1946) *In French.*—Photographic and photometric records were made with a phosphoroscope during the first 10 msec of the decay period. Among the green lines those due to transitions from higher levels show a relative increase as the decay proceeds. The reverse appears in the red region where some lines of low excitation (*s-p*) are the most persistent, possibly from a cascade effect in the emission mechanism. S. T. H.

535.372

6111. Multibanded emission spectra of zinc-cadmium sulphide phosphors. BYLER, W. H. Letter in *J. Opt. Soc. Amer.*, **39**, 91–2 (*Jan.*, 1949).—Structure in these spectra is demonstrated by comparison with known structureless sources. Spurious effects may be caused by reciprocity failure in the film, but can be eliminated by calibration against a standard source, using the same photographic density at the spectral region in question. [See Abstr. 931, 3265 (1948)]. S. T. H.

535.37

6112. On the fluorescence of solid dinormal propyl ketone. KASTHA, G. S. *Indian J. Phys.*, **23**, 107–1 (*March*, 1949).—The fluorescence of dinormal propyl ketone in the solid state at about −170°C has been studied using different exciting frequencies. It is observed that 4 strong fluorescence bands at 4 937, 5 251, 5 397 and 5 683 Å appear when the substance is solidified and cooled down to about −170°C. The bands do not appear at higher temps. below or above the m.p. of the substance. These bands are observed to be excited by Hg lines 4 046 group and other lines of shorter wavelength in the near u.v. When the solid at −170°C is illuminated by the Hg lines of still shorter wavelength in the u.v. region, a continuous fluorescence band extending from 4 000 Å up to about 4 600 Å is observed besides the 4 bands mentioned above. The significance of these results is discussed. A.

535.375.

6113. Polarisation of Raman lines of ethylene dibromide in solution, and intensities at different temperatures. BISHUI, B. M. *Indian J. Phys.*, **22**, 253– (*June*, 1948).—Polarization of Raman lines of ethylene dibromide was observed, when dissolved in methyl alcohol, benzene, toluene, CCl_4 and hexane. The line 1 056 cm^{-1} is totally depolarized in all the solvents except hexane, in which solution it is partially polarized. The ratio of the intensities of the 551 and 660 cm^{-1} lines was measured at 12, 30 and 95°C; it is found to diminish slightly at the highest temp. These facts support the view that the molecules are associated and the groups so formed have a plane of symmetry. A. C. M.

535.375.5

6114. On the Raman spectra of 1, 2- and 1, 1-dichloroethanes in the solid state. BISHUI, B. M. *Indian J. Phys.*, **22**, 319–24 (*July*, 1948).—Both substances in the liquid state yield 10 Raman lines having frequency-shifts of less than 1 100 cm^{-1}. Some of these lines disappear when 1, 2-dichloroethane is solidified, but in the case of the other substance all persist. It is suggested that these facts can be explained if the liquids in both cases contain strongly associated molecules. A. C. M.

535.375.5

6115. On the Raman spectra of *n*-propyl bromide and ethylene chlorhydrin in different states. BISHUI, B. M. *Indian J. Phys.*, **22**, 334–40 (*Aug.*, 1948).—Some intense Raman lines disappear when *n*-propyl bromide is solidified. Similar disappearance of lines could not be confirmed in ethylene chlorhydrin. The hypothesis is put forward to account for these facts, that the halogen atom of one propyl halide molecule forms a virtual bond with the C atom of a neighbouring molecule. A. C. M.

535.375.5

6116. Influence of an electric field on the depolarization factors of Raman lines. DOUGLAS, A. E. Letter in *J. Chem. Phys.*, **16**, 849–50 (*Aug.*, 1948).—Measurements of depolarization were made photoelectrically on Raman lines of benzene, CCl_4, cyclohexane and chlorobenzene, first with a direct field of 20 000 V/cm and then with an alternating one of 70 000 V/cm.

n no case could a change of depolarization factor be observed, and any change must have been $< 0{\cdot}01$. A. C. M.

535.375.5

6117. Low frequency Raman spectra of ammonium and potassium phosphates. CHAPELLE, J. *C.R. Acad. Sci., Paris*, **228**, 755–6 (*Feb.* 28, 1949) *In French.*—The low frequency translational vibrations in the mono-ammonium and mono-potassium phosphates are compared with the calculated values. In the NH_4 salt, this is helped by the attribution of a Raman line 176 cm^{-1} to a translatory vibration. Two lines are left over, for each crystal, and these are attributed to rotational oscillations. Assuming the same force constant in the two crystals, it is possible to calculate a ratio for the two crystals, viz. the ratio of the differences in the squares of the two frequencies. The calculated value is $1{\cdot}04$ while that obtained experimentally is $1{\cdot}03 \pm 0{\cdot}15$. A. C. M.

535.375.5

6118. Raman effect, infra-red absorption, dielectric constant, and electron diffraction in relation to internal rotation. MIZUSHIMA, S., MORINO, Y., WATANABE, I., IMANOUTI, T. AND YAMAGUCHI, S. *J. Chem. Phys.*, **17**, 591–4 (*July*, 1949).—The relative intensities of Raman lines of 1, 2-dichloroethane were determined in the gaseous state as well as in the liquid state. The result combined with that of the dipole measurement in the gaseous state enabled one to determine the equilibrium isomeric ratio of the *trans*- and the gauche molecules, which was in good agreement with that obtained from the absorption measurement of infra-red spectra. This ratio could also explain satisfactorily the result of an electron diffraction experiment made for the vapour of 1, 2-dichloroethane. The statistical entropy of dihalogenoethanes was calculated from the molecular data and was compared with the third law entropy obtained from the thermal measurement. The frequencies of torsional oscillation about the C–C bond as axis were determined by the difference method and were found to be in agreement with the lowest frequencies of the observed Raman spectra. A.

535.375.5

6119. Fundamental vibrations of monodeutero substituted ethylene. DE HEMPTINNE, M. AND COURTOY, C. (*Ann. Soc. Sci. Brux.*, **63** (*Sér.* 1) 98–103 (*June* 18, 1949) *In French.*—The Raman spectrum of C_2H_3D is reported, including depolarizations, as well as a preliminary study of the infrared spectrum. This allows an allocation of the observed frequencies to the normal modes of vibration of the model postulated for the molecule. A. C. M.

535.375.5

6120. Raman effect in single crystals of acid sulphates of potassium and ammonium. COUTURE, L. AND RICHE, N. *J. Phys. Radium*, **10**, 151–5 (*May*, 1949) *In French.*—The atomic structure of the acid sulphate of K is unknown; the object was to see if the Raman effect could show the disturbing effect of the H atoms on the SO_4 ions. All the lines observed were due to internal vibrations, and they were sharp. The polarizations of the lines were observed for different orientations of the crystal, and from the polarization states and the frequencies the authors conclude that ions SO_4H are present in the crystal. Spectra were also obtained for the NH_4 acid sulphates, NH_4HSO_4 and $(NH_4)_3H(SO_4)_2$. Owing to the great deliquescence of the former, only one spectrum was obtained at an unknown random orientation of the crystal, but from the frequencies both SO_4 and SO_4H ions are thought to be present. In the second acid sulphate, only one (known) orientation was possible, since the crystals were thin laminae; here again both SO_4 and SO_4H ions are thought to be present. A. C. M.

535.376 : 537.533.8

6121. On the saturation of fluorescence with cathode-ray excitation. BRIL, A. *Physica*, **15**, 361–79 (*May*, 1949) *In English.*—Measurements of the light output as a function of the beam current under stationary cathode-ray excitation are performed for Zn silicate activated with various concentrations of Mn or Ti and for ZnS activated with ZnCl and with AgCl. The intensity of fluorescence saturates at high current densities. Under continuous electron bombardment the saturation depends on the activator content, on the presence of quenchers and on the decay time of the fluorescence. The concentration of centres in ZnS–ZnCl is estimated. In the case of a spot of high current density scanning a definite area, the saturation does not depend on the decay time of fluorescence if the time in which the electron beam passes a certain point of this area is small with respect to the decay time. A.

535.376 : 537.542

6122. Fluorescence of anthracene excited by high energy radiation. ROTH, L. Letter in *Phys. Rev.*, **75**, 983 (*March*, 1949).—The spectra of scintillations, produced in single crystals of anthracene by Cu $K\alpha$ radiation, 10 MeV deuterons and mixed neutrons and γ-rays from a Ra–Be source, were measured between 2 500 and 5 000 Å. 3 bands were observed in each case, between 4 120 and 4 720 Å. The wavelengths of the band maxima agree with those obtained with u.v. excitation. To relate these results to counting properties, counts from a γ-source were measured at different pulse heights, using a 931 A photomultiplier separated from the crystal by filters; the observed transmittance ($0{\cdot}78$) agrees with the filter-maker's value ($0{\cdot}74$ between 4 200 and 4 700 Å). T. G. P.

535.39

6123. Reflecting power of glass with thin and thick film. VAŠIČEK, A. Letter in *J. Opt. Soc. Amer.*, **39**, 409 (*May*, 1949).—Formulae for the reflecting power of thin and thick films deposited on glass are normally derived separately. It is shown that the formula for the thick film can be derived from that for the thin film. A. C. M.

535.39

6124. On the preparation of hard oxide films with precisely controlled thickness on evaporated aluminium mirrors. HASS, G. *J. Opt. Soc. Amer.*, **39**, 532–40 (*July*, 1949).

535.39

6125. Silicon monoxide protected front-surface mirrors. HASS, G. AND SCOTT, N. W. *J. Opt. Soc. Amer.*, **39**, 179–84 (*Feb.*, 1949).—Gives an account of the technique and results of coating aluminized mirrors with a protective transparent layer of Si

monoxide. The protective coating is evaporated at a relatively low temp. and mirrors thus protected are highly resistant to salt water and abrasion. The reflectivity as affected by variations in film thickness and speed of coating is shown graphically. E. G. M.

535.39 : 621.385.833 : 537.533.35

Use of the electron microscope in the optical industry. *See Abstr.* 6247

535.412

6126. A new application of white-light superposition fringes. TOLANSKY, S. Letter in *Nature, Lond.*, **163**, 637 (*April* 23, 1949).—White-light fringes of equal inclination are well known, but white-light fringes of equal thickness have been little used. The fringes are readily demonstrated by silvering a cleavage slice of mica on both sides, cutting it in two, and superposing the two pieces in a parallel beam of white light. Owing to small cleavage steps in the mica sheet, the result is that particles of colour of different tints show up. Compared with fringes from a single sheet, the superposition fringes allow cleavage steps to be missed less easily, and the fringe-width is 40% finer. A suggested application is the figuring of optical slabs required to be of identical thickness. A. C. M.

535.417

6127. Interference phenomenon in the schlieren system. GAYHART, E. L. AND PRESCOTT, R. *J. Opt. Soc. Amer.*, **39**, 546–50 (*July*, 1949).—A diffraction phenomenon has been discovered in the schlieren system which makes possible a quantitative schlieren method. In this method bands are observed in the schlieren field. These bands represent regions in the schlieren through which the optical path length is constant and different from the schlieren free portion of the field by $(N + \frac{1}{2})$ wavelengths of the light used (where N represents an integer). It has been demonstrated that, within the experimental accuracy, these bands have the same meaning as those observed in the Mach–Zender type of interferometer when that instrument is adjusted so that one fringe covers the entire field. A.

535.417

6128. Recording interferometer for precision wavelength determinations. SITTNER, W. R. AND PECK, E. R. *J. Opt. Soc. Amer.*, **39**, 544–6 (*July*, 1949).—A recording interferometer is described which permits the precise measurement of an angle by means of interferometric measurement of chord length. The present instrument, working in conjunction with a recording spectrometer, is applied to the problem of precise wavelength determinations. Preliminary results indicate that the average deviation of a single measurement is 0·044 Å. The application of this interferometer to the measurement of linear or rotational motion is discussed. A.

535.42

6129. On Schaefer–Bergmann's diffraction diagrams of vibrating quartz crystals, produced when they are observed in directions not parallel to any of the crystallographic axes. NOMOTO, O. *J. Phys. Soc. Japan*, **3**, 30–2 (*Jan.–Feb.*, 1948) *In English.*—Extends former results obtained by the same author [*Proc. Phys.-Math. Soc. Japan*, **25**, 240 (1943)] to the case when the directions of observation are different from the crystallographic axes. Some experimental diffraction curves are given. They are shown to be in fair agreement with theoretical patterns, calculated from the elastic constants derived by Koga. F. I.

535.4

6130. Diffraction of light at a circular aperture in a black screen. DURAND, E. *C.R. Acad. Sci., Paris*, **226**, 1593–5 (*May* 19, 1948) *In French.*—An application of the method previously described [see Abstr. 19 (1949)]. L. I

535.42

6131. The production of diffraction gratings. II. The design of echelle gratings and spectrographs. HARRISON, G. R. *J. Opt. Soc. Amer.*, **39**, 522–8 (*July* 1949).—Gratings having a simple step groove form that reflects light of all orders in a narrow bundle and designed to be used at an angle of incidence $> 45°$ and normal to the narrow side of the "steps," may be designated "echelles," as intermediate in character between the echellette and the echelon. Echelles should lend themselves to production of very powerful compact spectrographs giving single exposure coverage of broad spectral ranges. A 10 in echelle having 1 000 grooves of width 0·25 mm, each with one flat side 0·05 mm deep, gives at 5 000 Å a theoretical resolving power of one million, a free spectral range of 5 Å and a plate factor of 0·2 Å/mm when used with a lens or mirror of only 250 cm focal length. It should thus be as powerful as a 10 in concave grating of 42 ft radius having 30 000 grooves per in when used in the third order, and would be much faster even though used with a lens of < 75 mm aperture. When crossed with a suitable prism or grating of low dispersion this echelle should, without overlapping of orders, produce spectrograms having a range of 10 000 wave numbers or more on a single plate, instead of the 5 to 25 plates required by the equivalent orthodox grating in the Paschen–Runge mount. The echelle spectrograph would also offer great gains in stability and portability. Problems and possibilities of the production of original and replica echelles are discussed, and it is shown that the reduction of ruling time from weeks to hours makes interferometric control of groove spacing in gratings appear feasible for the first time.

535.42

6132. Spectra given by photographically produced gratings; calculated and observed intensities. DE MARACHE, G. *C.R. Acad. Sci., Paris*, **223**, 80–1 (*July* 8, 1946) *In French.*—The periodicity and aperture width of 3 gratings were measured directly and the intensity of the various orders of spectra calculated. In 2 cases, the observed intensities corresponded to gratings of the same periodicity but of significantly smaller apertures, and in the third case there was no relation between calculation and experiment. A tentative explanation is that there is a phase shift at the boundaries of the apertures. N.

535.4

6133. Optical characteristics of sheets of scattering materials. LONGINI, R. L. *J. Opt. Soc. Amer.*, **3** 551–3 (*July*, 1949).—It is here shown, by geometr considerations, that the scattering equation for lar particles contains two coeffs., and their relationsh

o particle size is shown. The scattering coeff. proves o be inversely ∝ particle size while the absorption oeff. is independent of particle size. These coeffs. an be measured accurately, and measurement of the cattering coeff. may prove a reliable means of checking article size. The general expressions for the transnission and reflection of the sheets can be much implified for thin sheets of material having low bsorption. A.

535.43 : 541.18

Light scattering in soap solutions. *See Abstr.* 6401

535.43 : 551.521.3

Scattered and rescattered sunlight. *See Abstr.* 6608

535.51 : 535.56

6134. Reflection of light on isotropic media endowed with rotatory power. HERPIN, A. *Rev. Opt. (Théor. Instrum.)* **28,** 65–78 (*Feb.*, 1949) *In French.*—Discusses he effect when reflection occurs at the surface of a naterial which produces rotation of the plane of olarization. (The case of magnetic rotation is left or a later paper.) The general formulae for such eflections are established from classical considerations nd the intensity and state of polarization of the eflected waves examined. It is found that a vibration inearly polarized in the plane of incidence or normal o this plane gives an elliptical vibration on reflection, he ellipticity being small except in the neighbourhood f total reflection. An appendix deals with the vanescent wave occurring in the rarer medium when otal reflection occurs. H. G. J.

535.525

6135. Analysis of elliptical polarization. RICHARTZ, M. AND HSÜ, H.-Y. *J. Opt. Soc. Amer.*, **39,** 136–57 (*Feb.*, 1949).—The general problem of elliptical olarimetry consists of finding 3 parameters, namely osition (azimuth), form (ellipticity), the sense of the llipse described by the light vector together with the agnitude of the phase difference between the components. This paper gives a survey of methods of nding the parameters; an earlier paper by Jerrard [Abstr. 1218 (1948)] deals with the phase differences. he theoretical background for the methods discussed is first introduced; this uses the calculus of uaternions developed from the matrix theory of lark Jones. The theory is applied to the Szivessy "simple half-shade" and to the Brace compensator, he notation and results obtained being the same as n Jerrard's paper. The methods of analysis are ither (*a*) direct determination of the 3 parameters mploying an analyser with half-shadow device to nd the azimuth, a compensator to find the ellipticity nd finding the sense of the ellipse by considering the osition of the compensating system; or (*b*) indirect determination using the relation between the azimuth nd of the ellipticity with the phase difference and the atio of the amplitudes of the components of the ncident wave. The methods discussed for determining the azimuth are those using a double field analyser (Schönrock and Lippich types); those using a biplate changing the direction of the ellipse axes (Soleil and Nakamura types and a new "bi-rotator," details of which are given); those using a plate covering half the field and reversing the sense of the ellipse (Chauvin and Chaumont types) and those using a doubly refracting biplate which changes the direction and form of the ellipse (Calderon, Sommerfeld and Bravais types). The measurement of ellipticity is discussed with reference to methods using (*a*) a half shadow plate only (Richartz, Szivessy), (*b*) a biplate (Calderon), (*c*) a compensating plate in conjunction with a half-shade device (Senarmont, Richartz, MacCullagh Stokes and Brace compensator). Details for the determination of the sense of rotation are given. Finally two indirect methods of analysis are mentioned, one using a Soleil compensator in conjunction with Szivessy's half-shadow plate and the other being Voigt's method. [See Abstr. 1060 (1901), 1339 (1903), 1427 (1910), 983 (1920), 1852 (1925), 352, 1704 (1927), 1589 (1932), 3234, 4499, 4500 (1938), 1271, 2083 (1941), 2121 (1947)]. H. G. J.

535.55 : 541.64

Double refraction in rubber. *See Abstr.* 6525

535.566.2

6136. Refraction and Faraday effect of rare earth ions in aqueous solutions. OKAZAKI, A. *J. Phys. Soc. Japan*, **1,** 1–3 (*July–Dec.*, 1946) *In English.*—From published data on refractive indices and Verdet constants are derived the ionic refractions and ionic rotations of the trivalent La, Ce, Pr, Sm and Eu ions. D. H. W.

535.6 : 621.327.43

6137. The colour of fluorescent lamps. HARRISON, W. *Trans. Illum. Engng Soc., Lond.*, **14** (*No.* 6) 145–73 (1949).—The relation between the spectral distribution and colour rendering quality of illuminants is discussed with particular reference to the spectral distribution differences which can be experienced with white fluorescent lamps. Because of the subjective nature of colour appreciation, factors such as colour preferences and colour contrasts are of great importance in fluorescent lamp colour design. The respective functions of chromaticity co-ordinates and spectral band measurements are indicated. The colour of a fluorescent lamp itself can be accurately specified by its C.I.E. co-ordinates, and tolerances of any desired magnitude can readily be fixed. For an adequate specification of the colour rendering quality, however, it is necessary that the spectral distribution be known. Eight spectral-band and chromaticity co-ordinate data are given for the principal phosphors employed in fluorescent lamps. A brief survey of the colours of natural daylight and incandescent light is included. Reasons are given favouring the design of fluorescent lamp colours for general lighting service on the purple side of the black body locus, as evidenced in the Warm White and Natural lamps. Recent developments in the application of fluorescent lamps to colour matching include lamps with $\sim 6\,500°K$ black body spectral distribution and mixtures of blue fluorescent and incandescent light. A.

535.6.08

6138. Color-order systems. Foss, C. E. *J. Soc. Mot. Pict. Engrs*, **52,** 184–96 (*Feb.*, 1949).—A general discussion of colour description by matching with samples, followed by a more detailed account of certain systems, viz. the Plochere (1 248 samples of paints), the Martin–Senour (Nu–Hue), also for paints,

and the older systems of Ridgway, Ostwald, Maerz and Paul, and Munsell. J. W. T. W.

535.642.1

6139. Just noticeable colour differences as related to Young's theory. LE GRAND, Y. *Rev. Opt.* (*Théor. Instrum.*) **28,** 261–78 (*May*, 1949) *In French.*—The system of ellipses which represents invariant colour matches in the chromaticity diagram is explained on the basis of the trichromatic theory by the introduction of Fick's hypothesis of the fusion of the red and green sensations. The mathematical treatment is based on a number of arbitrary, simple assumptions; MacAdam's experimental results [Abstr. 2329 (1942)] are used. Ladd–Franklin's theory is recalled, and the idea of a non-Euclidean colour space is rejected because it would involve the abandonment of the Young–Helmholtz theory. Tables and graphs are given. R. A. W.

535.65

6140. Determination of relative color density of liquids. LYKKEN, L. AND RAE, J., JR. *Analyt. Chem.*, **21,** 787–93 (*July*, 1949).—A rapid method for the reproducible photoelectric determination of the relative colour density of liquid products involves measurement of the optical density of the test material relative to that of an easily prepared liquid colour standard selected to approximate the test material in hue and colour density. This method is especially useful as a specification method for measuring colour density which is often taken as a criterion of purity, or as a control method for following manufacturing or refining processes. A.

535.65

6141. The Ridgway color standards with a Munsell notation key. HAMLY, D. H. *J. Opt. Soc. Amer.*, **39,** 592–9 (*July*, 1949).

535.8

6142. Study of the effects of layers of hot air produced in optical instruments. VIMONT, P. *Rev. Opt.* (*Théor. Instrum.*) **28,** 193–211 (*April*, 1949) *In French.*—It has been found that errors in range-finders produced by temp. variations in the interior of the instrument are significant. If the index of a layer of air at height x in the tube is $n = n_0 + x/k$, it is shown that the angular error in traversing a length L is approx. $\Delta\alpha = L/K$. It was found possible to reduce the error by enclosing the light-path in a second tube inside the outer tube of the range-finder. H. H. HOP.

535.8 : 539.213

6143. On the mechanism of optical polishing. RAY, K. Letter in *J. Opt. Soc. Amer.*, **39,** 92 (*Jan.*, 1949).—A few observations on the unsolved question of whether rouge polishing cuts or smooths glass surfaces. Notes on fine surface cracks in old lenses with measured depths are given, also a useful bibliography. E. G. M.

535.823

6144. Image contrast in phase-contrast microscopy. KECK, P. H. AND BRICE, A. T. *J. Opt. Soc. Amer.*, **39,** 507–14 (*July*, 1949).—The development of applications of the Zernike, or phase-contrast, principle in microscopy offers not only an image of the object more precisely resembling it than any other heretofore obtainable, but even a new method of perception, by means of which certain characteristics of objec heretofore invisible may be determined by immedia inspection. The application of the fullest capabili of this method waits the development of procedur for more exactly determining the optical chara teristics of objects, particularly the effect on the lig of refraction and absorption characteristics combin at single points. The studies and conclusions report in this paper represent an effort to simplify the evalu tion procedure, and present a first approximation the influence of the factors involved in phase-contra image formation.

535.87 : 536.

6145. A method of measuring high intensities at t focus of a parabolic reflector with large relati aperture. DAVIS, G. E. *J. Opt. Soc. Amer.*, 3 541–3 (*July*, 1949).—A receiving cell with spec stops is used to determine the energy distributi thermoelectrically. The sources of error with t different types of aperture are discussed. Errors d to heat radiated from the stop are minimized by usi short exposures and by substituting a reflector for t stop immediately after the exposure. A suitab mount and adjusting mechanism for the cell a described.

535.89 : 621.327

6146. A flash lamp for illuminating vapour trac in the Wilson cloud chamber. WARMOLTZ, N. A HELMER, A. M. C. *Philips Tech. Rev.*, **10,** 178– (*Dec.*, 1948).—Requirements and design of a fla lamp suitable for the illumination of cloud chamb tracks are discussed. It is an elongated Xe-filled tub across which a capacitor charged to several kV discharged in a choke. The resultant flash has duration of a few msec. The lamp is simple in u with a high efficiency.

HEAT 536

536.

6147. Thermal conductivity of gases and aggrega matter. STRICKLER, H. S. Letter in *J. Chem. Phy* **17,** 427–8 (*April*, 1949).—The direct determination high temp. of gaseous thermal conductivities prese great difficulties. It is suggested that determinatio of the thermal conductivities of aggregates of varyi porosity on extrapolation to 100% porosity shou enable the conductivity of the gas to be foun Relative conductivities should be obtainable fro experiments with the same aggregate and differe gases. Data at 700°c and 0°c suggests a line relationship between conductivity and porosity f MgO. F. E.

536.

6148. Conduction of heat in a flame of aton hydrogen. VAN DER HELD, E. F. M. AND VAN D BOLD, H. J. *Physica*, **15,** 305–15 (*May*, 1949). The transport of heat in a vertical H flame, in whi the molecules are dissociated by an electric a has been calculated for the following cases: (1) flu tuating heat production concentrated in one poi (2) fluctuating heat production concentrated in o line of length l. The calculation shows that t

uctuation cannot penetrate to the spots where the mp. was measured. The temps. along the axis of ne flame, reduced to an appropriate scale, have been lotted against $1/z$ and against $1/\sqrt{z}$ (z being the eight above the heat source), in one of which cases straight line should be obtained according to theory. he horizontal temp. distribution in the above-nentioned scale is in good agreement with theory.)eviations are discussed and a table of theoretical alues of temp. is given. Temps. have been measured y line reversal and the results obtained have been ollected in a table. A.

536.24

6149. A problem of the temperature distribution in moving medium. BENFIELD, A. E. *Quart. Appl. Math.*, **6**, 439–43 (*Jan.*, 1949).—The temperature $T(x, t)$ in a semi-infinite medium moving with velocity $v > 0$ in the negative x direction is determined under he conditions: (i) the material does not pass the lane $x = 0$ but is annihilated there without evolution f heat; (ii) $T(x, 0) = Ax$; (iii) $T(0, t) = -\lambda t$. t and λ are constants. With these boundary con-itions, the equation

$$K\frac{\partial^2 T}{\partial x^2} + v\frac{\partial T}{\partial x} = \frac{\partial T}{\partial t}$$

s solved using the Laplace transformation method.

M. R. H.

536.24

6150. The laminar-film hypothesis. MILLER, B. *Trans. Amer. Soc. Mech. Engrs*, **71**, 357–67 (*May*, 949).—The experimental and theoretical investiga-ions into the validity of the laminar-film hypothesis sed in heat transfer literature are reviewed. This ypothesis explains the correlation between the rate f heat transfer between a tube and a fluid flowing hrough it and the pressure gradient in the fluid by ssuming that a heat resisting fluid film, in which the low is laminar, exists at the wall of the tube, and that he remainder of the fluid forms a turbulent core. The experimental measurement of the velocity distribution in the fluid, by Stanton, showed that here was a transitional zone of flow intermediate between turbulent and laminar flow. Von Kármán adopted the 3-zone theory which included this third transitional zone of fluid flow, and he used an experi-mentally determined velocity distribution, published by Nikuradse, to provide the thicknesses of the laminar film and transitional zone respectively. It is shown that no reliable prediction of a laminar film can be made from Nikuradse's experiments, and also that the form of the velocity distribution he pub-lished, which was used by von Kármán (above), was adjusted to seem in accord with the laminar-film hypothesis. W. H. D.

536.24

6151. Study of the transmission of cold by natural convection and the formation of frost. FENIGER, K. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 8) 248–65 (1949) *In French.*—The thermal and velocity fields round a cooled pipe are deduced theoretically to enable the heat transfer to be determined under refrigerating conditions. Experimental equipment is illustrated and described and graphs show the rate of frost formation, the variation in density of the layer and the overall heat transfer coeff. The variations in the structure of the frost are shown in photographs.

E. H. D.

536.24.08

6152. Investigations on the thermal conduction of salt solutions used in refrigeration. RAU, W. *Z. angew. Phys.*, **1**, 211–22 (*Nov.*, 1948) *In German.*—The method of Hammann [Abstr. 4165 (1938)] is used to measure the thermal conductivities, λ, of aqueous solutions of NaCl, KCl, $MgCl_2$, $CaCl_2$, NH_4Cl and a refrigerant (Reinhartin–Kühlsol) consisting of a mixture of mainly $CaCl_2$ and $MgCl_2$, for various concentrations and temperatures. The apparatus is described in detail. For constant concentration λ increases linearly with temp. For each of the substances λ is least at the cryohydric point, but only for the refrigerant is there no discontinuous break in the λ/concentration isotherms at this point. The results are exhibited in tabular and graphical form.

S. W.

536.242

6153. A new method for the comparison of the thermal conductivities of fluids. I. BOSWORTH, R. C. L. *J. Proc. Roy. Soc., N.S.W.*, **81** (*No.* 3) 156–66 (1947).—A rapid method of measuring the relative thermal conductivities and convective moduli of fluids is described, where the free convection heat loss is measured for a heated straight wire immersed in the fluid. When the surface heat transfer coeff. is plotted against $\theta^{\frac{1}{3}}$, where θ is the temp. difference between surface and bulk fluid, straight lines are obtained; the slopes of these lines provide the convective moduli, and the limiting heat transfer coeff. (as θ tends to zero) are independent of the orientation of the wire and provide the thermal conductivities of the fluids. Measurements on 15 different liquids and air are in good agreement with existing data, but the method is unsuitable for fluids which are very volatile or have a high electrical conductivity. W. H. D.

536.242

6154. A new method for the comparison of the thermal conductivities of fluids. II. BOSWORTH, R. C. L. *J. Proc. Roy. Soc., N.S.W.*, **81** (*No.* 3) 210–15 (1947).—The thermal conductivities and convective moduli of binary solutions of KCl-water, sucrose-water and glycerine-water at 27°c have been measured over a large range of concentrations by the method described by the author in *J. Proc. Roy. Soc., N.S.W.*, **81** (*No.* 3) 156–66 (1947). The measured convective moduli are in good agreement with the calculated values using the measured thermal conductivity and accepted values of other physical properties of the solutions. W. H. D.

536.25

6155. Dissipation of heat by free convection. II. ELENBAAS, W. *Philips Res. Rep.*, **3**, 450–65 (*Dec.*, 1948).—See Abstr. 987 (1949).

536.33

6156. Radiant heat transfer to receivers moving along the axis of a right circular cylindrical chamber. PENNER, S. S. Letter in *J. Opt. Soc. Amer.*, **39**, 200 (*Feb.*, 1949).—An earlier approximate calculation [Abstr. 3309 (1948)] has been refined by allowing for the fact that radiant energy incident upon the receivers

is ∝ the apparent area of the bounding surfaces of the chamber as seen from the receivers. The effect of this refinement is to reduce the mean value of the calculated incident radiant energy by approx. 20%.

A. SCH.

536.41 : 548.0

Investigation of thermal dilation of cubic metals. *See Abstr.* 6541

536.412

6157. Discontinuities in properties of water as a function of temperature. ANTONOFF, G. AND CONAN, R. J. *Science*, **109**, 255–6 (*March* 11, 1949).—It is stated that in the density/temp. curve of purified propyl alcohol, determined by a pycnometer, for temp. range 20–80°C, a kink was found at the same place as that obtained by Young [Abstr. 1785 (1910)]. Results of Conan's experiments on distilled water using a 25 cm³ pycnometer for range 47–53°C are shown graphically and a well-defined kink is obtained at ~ 50°C. S. W.

536.413 : 535.323

Coefficients of expansion of optical glasses at low temperatures. *See Abstr.* 6070

536.42

6158. Errata: Rate of nucleation in condensed systems. FISHER, J. C. Letter in *J. Chem. Phys.*, **17**, 429 (*April*, 1949).—See Abstr. 3166 (1949). 2 eqs. corrected.

536.42.031

6159. Rate of nucleation of solid particles in a subcooled liquid. FISHER, J. C., HOLLOMON, J. H. AND TURNBULL, D. *Science*, **109**, 168–9 (*Feb.* 15, 1947).—The existence of a crit. temp. of supercooling above which transformation does not take place is shown to be consistent with the theory of nucleation.

A. J. M.

536.423

6160. [Contribution] to the forced condensation [in the case] of arsenious oxide. STRANSKI, I. N. AND WOLFF, G. *Z. Naturforsch*, **4a**, 21–7 (*April*, 1949) *In German.*—It has been shown that the activation of As_4O_6 molecules can be brought about thermally as well as by impacts of ions. The order of magnitude of the energy of activation has been determined. The structure of the condensate is vitreous, but under the catalytic influence of humid air it assumes a transition (claudetite or claudetite-like) structure, and finally the arsenolith structure. The calculation of the results makes it possible to have a better insight into the mechanism of condensation. The condensation is possible when the concentration of the partially dissociated molecules is great and the speed of vaporization of the condensate is insignificant. The same effect has been encountered with P_2O_5, As_2O_5, P, As and Sb_2O_3. F. L.

536.46

6161. Cell structure of propane flames burning in tubes. MARKSTEIN, G. H. Letter in *J. Chem. Phys.*, **17**, 428–9 (*April*, 1949).—Flames of unusual structure have been observed in propane-air and propane-air-nitrogen mixtures. Premixed gases entered tubes from 2¾ in to 4 in dia. and laminar flow was established at the tube tops. As well-defined compositions were reached hemispherical cusps formed near the tube axis in the primary combustion zone. Furth reduction of propane concentration caused the latt to enter the tube and assume a structure compos of many cusps of fairly uniform size in consta irregular motion. A dimensional argument is state to indicate that the dia. of the cells should be ∝ t thickness of the combustion zone. The size of t cells was found to vary roughly inversely wi pressure in accordance with this conclusion. F. E.

536.46 : 535.338

Combustion studies with the orthicon spectrograp *See Abstr.* 6087

536.4

6162. On the theory of superfluidity. LANDAU, L. TISZA, L. Letters in *Phys. Rev.*, **75**, 884–6 (*March* 1949).—The two papers elucidate the differenc between the two authors in their approach t the theory of superfluidity. In the phenomenc logical theory are some differences in so far a Landau includes the phonons in the normal phas whereas Tisza in the present form of his theor includes them in the superfluid phase and assume proportionality of the entropy with the density of th normal phase. These are questions which still awa experimental clarification by measurements belo 1°K. In addition there are some differences regardin the terms quadratic in the velocity. Some other poin in the two theories are mutually criticized. H.

536.4

6163. On the irreversible processes in liquid helium I GORTER, C. J. AND MELLINK, J. H. *Physica*, **15**, 285 304 (*May*, 1949) *In English.*—It is pointed out tha the 2-fluid model can account for a number of th peculiar properties of liquid helium II. An attemp is made to use this model, in the form proposed b Tisza, for an analysis of the heat flows in slits an capillaries. Allen and Reekie's rule that heat flo and fountain effect are proportional is explained, an from the proportionality constant for rather narro slits the viscosity of the normal fluid is calculate The calculated values are found to be in agreemer with those obtained from oscillating disc experiment If the 2 fluids move with respect to one another mutual friction appears to occur which, in firs approximation, is ∝ the cube of the mutual velocity Assuming this, the equations of motion for the fluids are given in addition to a series of formula and predictions about heat flow, flow of matte mechano-caloric effect and the extinction of temp waves (second sound). A more careful examinatio of the experimental data reveals that the heat flow i capillaries of 1 μ and narrower is > expected. Thi may perhaps be due to a mean free path effect in th normal fluid. The proportionality of the mutua friction to the cube of the relative velocity is no too well realized in wide capillaries at the highe velocities. This might perhaps be ascribed to tu bulence effects in the superfluid phase which wa supposed to have zero viscosity. A

536.5.081 : 536.4

6164. Corrigendum: The establishment of the ab solute scale of temperature below 1°K. COOKE, A. H *Proc. Phys. Soc. Lond. A*, **62**, 534 (*Aug.*, 1949).—Se Abstr. 3183 (1949).

536.52 : 621.317.39

6165. Industrial high-speed infrared pyrometer. GORRILL, W. S. *Electronics*, **22**, 112–14 (*March*, 1949).—The soldering temp. of tin cans on a conveyor belt is measured by directing the infrared radiation, after passing through a 300 c/s chopper, on to a bolometer connected in series with a similar but unexposed element. The resulting signal voltage passes through a pre-amplifier and a 200–400 c/s main amplifier to a c.r.o. The latter has a sweep frequency variable from 1 to 7 c/s, corresponding to the speed of traverse of the cans. Calibration is effected by checking against the radiation from a controlled sample. Input noise is reduced by the use of rigid and shielded signal leads, noise-free resistors and d.c. for filament supply. Temp. is measured over the range 400–700°F to an accuracy of ± 5°F.

H. G. M. S. (R)

536.521

6166. Accuracy of measurement of technical optical pyrometers. JAGERSBERGER, A. *Bull. Ass. Suisse Élect.*, **40**, 179–86 (*April* 2, 1949) *In German.*—Two forms, (*a*) and (*b*), of the disappearing-filament type of pyrometer are considered. In (*a*) the brightnesses of the image of the source, and the filament, are matched by adjusting the filament current, and in (*b*), using a fixed filament current, by the insertion of an absorption wedge. The several errors introduced, in the matching, by the instruments, and the calibration, are separately discussed, and numerical values given. (*a*), and (*b*) with the cross-filament pyrometer lamp of Grüss, H., and Haase, G. [*Siemens. Z.*, **11**, 297–301 (1931)] are considered to be best suited for temp. measurement. S. W.

536.522.3

6167. Temperature measurements of flames containing incandescent particles. WOLFHARD, H. G. AND PARKER, W. G. *Proc. Phys. Soc. Lond. B*, **62**, 523–9 (*Aug.*, 1949).—Colour temps. measured on photoflash powders are > expected from theoretical calculations. Determinations of the true temp. of stationary flames of Al flakes suspended in air have been made (*a*) by a line reversal method and (*b*) by measuring the absolute light intensity. The experimental values obtained were very close to the theoretical flame temp. of about 3 000°C, that is, the boiling point of the oxide. An explanation is offered for the difference between the true temp. and colour temp. for flames containing incandescent particles, the reason being the small size of the radiant particles, which introduce optical anomalies. It is concluded therefore to be unprofitable to measure the colour temp. at all as this has no relation to the true temp. Mg behaved very similarly, the true temp. being the melting point of MgO, near 2 800°C, whereas the colour temp. is above 3 900°K. The two-colour method of Hottel and Broughton for temp. measurements in hydrocarbon flames is examined in the light of this experience. A.

536.53 : 535.87

A method of measuring high intensities at the focus of a parabolic reflector. *See Abstr.* 6145

536.53 : 621.317.72.027.21

6168. A thermocouple microvoltmeter for use in the differential thermal analysis of clays. THERON, J. J. *J. Sci. Instrum. Phys. Ind.*, **26**, 233–5 (*July*, 1949).—An electronic microvoltmeter for measuring and recording the voltages generated by the differential thermocouple in the differential thermal analysis of clays is described. The instrument is quite stable and has a max. noise level and drift of 1 μV at full sensitivity over the period required for the experiment. A.

536.531 : 621.316.86

6169. Compensation method for thermistor beads. ANDERSON, L. J. *Bull. Amer. Met. Soc.*, **30**, 192–3 (*May*, 1949).—Using a compensation network with fixed resistances, a method, involving no assumptions regarding the shape of the curve, for matching a series of thermistor bead temp. elements to a single resistance-temp. calibration curve, is described. The elements are matched at two temps. which, for the range — 5 to 35°C, are recommended to be 0 and 30°C. The results, in tabular form, of the compensations attained by this and by Gordon and Seay's method [Abstr. 212 (1949)] for Sanborn ceramic-rod, and for Western Electric thermistor bead, elements, are given, the ratio of the spreads being about 1 to 3. The dependence on thermal sensitivity is considered. S. W.

536.633

6170. The heat capacity of organic vapors. V. Acetaldehyde. COLEMAN, C. F. AND DE VRIES, T. *J. Amer. Chem. Soc.*, **71**, 2839–41 (*Aug.*, 1949).—The heat capacity of acetaldehyde was determined at 1 atm. and 25, 50, 100 and 150°, using a direct-flow calorimeter. The vapour was heated electrically; the increase in temp. was measured with Pt resistance thermometers. The density of acetaldehyde at 0 and 25°, and the heat of vaporization at 1 atm. were also determined.

536.633

6171. The heat capacity of organic vapours. VI. Acetone. COLLINS, B. T., COLEMAN, C. F. AND DE VRIES, T. *J. Amer. Chem. Soc.*, **74**, 2929-31 (*Aug.*, 1949).

536.66 : 541.57

6172. The dissociation energy of the first N–H bond in ammonia. SZWARC, M. Letter in *J. Chem. Phys.*, **17**, 505–7 (*May*, 1949).—From the pyrolysis of N_2H_4, with toluene as carrier, the energy of dissociation to two NH_2 radicals is found to be 60 ± 3 kcal/mole, giving 104 ± 2 for $D(NH_2 - H)$. Pyrolysis of benzylamine confirms this. The result strongly supports the value of 225 kcal/mole for $D(N_2)$. A. G. G.

536.662

6173. Studies in combustion calorimetry applied to organo-sulphur compounds. SUNNER, S. *Lund A.-B.Ph. Lindstedts Univ.-Bokhandel* (1949) 112 *pp. In English.*—A combustion calorimeter with rotating bomb is described which reduces the uncertainty in the determination of the heats of combustion of organic sulphur compounds to about 10^{-4}. Systematic errors have been eliminated by applying the method of comparative measurements. Washburn corrections have been applied, and the value of the correction for CO_2 has been improved by determining the solubility of CO_2 in H_2O and in diluted H_2SO_4. The heat of combustion of rhombic S has been determined

as S(rhomb.) + $H_2O(l)$ + $\frac{3}{2}O_2(g)$ = H_2SO_4,115H_2O + 143·0$_5$ ± 0·10 kcal/mole, at V = const. and T = 20·00°C. Heats of combustion of ethylene sulphide, all methyl-substituted ethylene sulphides and the tri- to hexamethylene-sulphides have been determined and the heats of formation calculated. F. L.

536.662

6174. The heats of formation of sodium borohydride, lithium borohydride and lithium aluminium hydride. DAVIS, W. D., MASON, L. S. AND STEGEMAN, G. *J. Amer. Chem. Soc.*, **71**, 2775–81 (*Aug.*, 1949).—A "bomb" calorimeter was used to determine the heats of reaction of sodium borohydride, lithium borohydride and lithium aluminum hydride with an excess of dilute hydrochloric acid. The heat effects were measured with a precision of 0·11, 0·35 and 0·20%, respectively. The specific heats and densities of the 3 hydrides were determined and, where significant, other thermal data were obtained so that the heats of formation of the hydrides at 25° could be calculated. The standard state chosen for B was B (solid, amorphous). The values for the standard heats of formation in kcal/mole were: sodium borohydride, − 43·83 ± 0·07; lithium borohydride, − 44·15 ± 0·30; lithium aluminium hydride, − 24·08 ± 0·35. A.

THERMODYNAMICS 536.7/.8

536.71

6175. 0°- and 100°-isotherms of helium, hydrogen, neon, argon, air and carbon dioxide at pressures below 2 atmospheres and the absolute temperature of 0°C. ŌISHI, J. *J. Sci. Res. Inst., Tokio*, **43**, 220–31 (*June*, 1949) *In English.*—0°- and 100°-isotherms of He, H_2, Ne, A, air and CO_2 at pressures below 2 atmospheres were determined. T_0, the absolute temperature of 0°C, was obtained as 273·15°. From the existing data obtained by authoritative workers since 1929, the value of T_0 is taken as T_0 = 273·155° ± 0·015°. A.

536.71 : 539.11

6176. On a new equation of state. CORSON, E. M. Letter in *Phys. Rev.*, **75**, 1264 (*April* 15, 1949) *In English.*—A new equation of state describing many solids, compounds and liquids has been obtained from very general principles of quantum mechanics and statistics, starting from a more precise analysis of the electron gas, and taking advantage of the fact that the zero-point pressures are generally very great compared to obtainable applied pressures. The equation should apply to conducting solids, certain valence crystals, and liquids, but not to ionic crystals or certain molecular solids. This has been found to be the case and agreement within ½% is obtained with the data of Bridgman in all cases. The specific heat equation resulting from the theory is of the Einstein form, but with a factor λR instead of $3R$. Excellent agreement has been found for the change of relative resistivity under pressure. F. E. H.

536.73 : 536.71

6177. Discussion of "On the second law from the standpoint of the equation of state." PRIGOGINE, I., VAN RYSSELBERGHE, P. AND FINCK, J. L. *J. Franklin Inst.*, **247**, 497–504 (*May*, 1949).—A discussi between Finck, and Prigogine and Van Rysselberg In recent papers [Abstr. 2144 (1947); 3321 (194 Finck has examined the logical structure of therm dynamics. Prigogine and Van Rysselberghe maint that in these papers a completely erroneous presen tion of the thermodynamic method of De Don has been given. The discussion turns upon t definition of affinity and the number of independ variables necessary to define equilibrium and her reversibility in a thermodynamic process. T conflict of ideas is unresolved by this interchange opinion. F. E.

536.

6178. Thermodynamic functions of CH_3SH a $(CH_3)_2S$. BINDER, J. L. Letter in *J. Chem. Phys.*, 499–500 (*May*, 1949).—Entropies, free energies, h capacities and heat contents of CH_3SH and $(CH_3$ have been calculated for several temps. The hinde rotation potentials are 1 460 and 1 900 g.-cals/m respectively. Functions are derived and free energ of formation. W. R.

536

6179. Hydrazine: heat capacity, heats of fusi and vaporization, vapor pressure, entropy and therm dynamic functions. SCOTT, D. W., OLIVER, G. D GROSS, M. E., HUBBARD, W. N. and HUFFMAN, H. M. *J. Amer. Chem. Soc.*, **71**, 2293–7 (*July*, 1949).—T heat capacity of hydrazine has been measured ov the temp. range 12 to 340°K, and the vapour pressu over the temp. range 0 to 70°K. From the above da the entropy of the vapour at 298·16°K was compu to be 56·97 ± 0·30 cal/deg/mole. Using spectr scopic and molecular structure data, thermodynam functions were calculated over the range 298·16 1 500°K.

536.752 : 539.1

6180. Thermodynamics and vibrational spectrum acetaldehyde. PITZER, K. S. AND WELTNER, W., *J. Amer. Chem. Soc.*, **71**, 2842–4 (*Aug.*, 1949). The assignments of vibrational frequencies acetaldehyde and acetaldehyde-d_4 are revised so to agree with the heat capacity of gaseous acetaldehy in addition to the observed spectra and the produ rule. A potential barrier to internal rotation 1 000 cal/mole is found to give best agreement w thermodynamic data which include the equilibriu with H and ethanol in addition to the heat capac of gaseous acetaldehyde. A tabular summary thermodynamic properties is given.

ELECTRICITY 537

537

6181. Electrical apparatus shown at the Physi Society's Exhibition. RYMER, T. B. *J. Sci. Instrum Phys. Ind.*, **26**, 183–5 (*June*, 1949).

THEORY . ELECTRONS 537.1

537.1

6182. On radiative corrections to electron scatterin SCHWINGER, J. Letter in *Phys. Rev.*, **75**, 898

March 1, 1949).—The first order radiative correction the cross-section for essentially elastic scattering an electron by a Coulomb field is calculated, using e author's covariant form of quantum electro-namics, and the result expressed as a fractional crease in the differential cross-section for scattering rough a given angle. The emission and absorption virtual quanta and the real emission of quanta th max. energy ΔE which is small in comparison th $W = E - MC^2$, the initial kinetic energy of the ectron, are taken into account; i.e. the contribution inelastic events in which a small fraction of the iginal energy is radiated is included. No correction made for the divergence at the low frequency limit $E \to 0$), due to the neglect of higher order pro-sses [Bloch and Nordsieck: Abstr. 4026 (1937)], this region is inaccessible to experiment. The diative corrections so obtained in the relativistic gion, with W about 3 MeV and ΔE 50 keV, are ite considerable, being of the order of a few %. perimental verification of these predictions would pplement the evidence in the non-relativistic region energy level shifts due to radiative reaction, as own by the Lamb–Retherford experiment bstr. 3606 (1947)] and in the anomalous magnetic oment of the electron [Abstr. 3860 (1948)]. H. McM.

537.122

83. Determination of e/m from recent experiments nuclear resonance. THOMAS, H. A., DRISCOLL, R. L. ND HIPPLE, J. A. Letter in *Phys. Rev.*, **75**, 992 *April* 15, 1949).—$e/m = 1{\cdot}75878 \pm 0{\cdot}00016 \times 10^7$ derivation from recent experiments determining $_1$ and γ_p. D. H. W.

537.122 : 530.145.63

The acceleration of the Dirac electron. *See Abstr.* 68.

537.13

84. On the "positive tracks" on Wilson photos. AA, J. H. AND SIZOO, G. J. *Physica*, **15**, 316–26 *May*, 1949) *In English.*—With a 30 cm cloud chamber, periments have been made on the emission of sitive particles by a UX-source. From the negative sult of these experiments it is concluded that the mber of positive tracks is $< \frac{1}{10}$ that found in earlier periments in which no collimation was used. A gative result was also obtained in an experiment which an Al-foil was bombarded by electrons of out 1·2 MeV, in order to check the abnormally gh occurrence of the production of pairs, as had en suggested by the earlier experiments. A.

537.13 : 539.152.2

Measurement of the proton moment in absolute its. *See Abstr.* 6367

ELECTROSTATICS . DIELECTRICS 537.2

537.226

85. Dielectric constants and molecular structure. Relationship of the new equation to previous uations. KULKARNI JATKAR, S. K. AND YATHIRAJA ENGAR, B. R. *J. Indian Inst. Sci.*, **30 A** (*No.* 4) 27–37 (1949).—See Abstr. 2146 (1947). Experimental verification of existing theories for dilute solutions and for pure liquids is fortuitous. The anomalous variation of the Debye–Clausius–Mosotti polarization with concentration is corrected in the author's new equation. Linear dependence of dielectric constant with concentration and polarization at infinite dilution are claimed to be more adequately represented by the new equation. W. R. A.

537.226.08

6186. Ponderometric determination of dielectric properties. GAST, T. AND ALPERS, E. *Z. angew. Phys.*, **1**, 228–32 (*Nov.*, 1948) *In German.*—A method is described for determining the permittivity (κ) of solid insulating materials from measurements by means of a sensitive electrical balance of the force exerted on a small sphere of the material in an alternating electric field. The power factor is determined from measurements of the torsional moment in a rotating field. Results for plasticized polyvinyl chloride at frequencies between 50 c/s and 100 Mc/s and at temps. between −50° and 150°c are quoted: the max. errors on the dielectric constant values are estimated to be between 5 and 20% for κ between 2·5 and 20, and on power factor between 10 and 50% for κ between 1 and 20. E. R.

537.226.2

6187. The dielectric behaviour of $BaTiO_3$ single-domain crystals. MERZ, W. J. Letter in *Phys. Rev.*, **75**, 687 (*Feb.* 15, 1949).—The dielectric constants $\varepsilon_a, \parallel$ and $\varepsilon_c, \perp$ to the polar axis were measured in the temp. range −175 to 130°c. ε_a is found to be $> \varepsilon_c$ in the ratio 20 : 1 at room temp., but $\varepsilon_a = \varepsilon_c$ at the Curie point (120°c) when the crystals take up the cubic modification. The difference in values of ε between the Curie point and 0°c is due to a partial displacement of the Ti ions. An analogous behaviour is observed between 0°c and −85°c, the next transition point. In contrast to the results of Mason and Matthias [Abstr. 2492 (1949)] no fall in ε_a up to 40 Mc/s is found, and the author concludes that his specimens were more pure. C. A. H.

537.226.2

6188. Dielectric constant of barium titanate at high temperatures. ROBERTS, S. Letter in *Phys. Rev.*, **75**, 989–90 (*April* 15, 1949).—Measurements at 1 Mc/s show that the dielectric constant, κ, at temps. between 150° and 350°c is represented by the Curie–Weiss relation: $\kappa = C/(T - T_c)$, where T is the temp. and C and T_c are constants; and not by the relation: $\kappa = \kappa_0 + C/(T - T_c)$, where κ_0 is the dielectric constant at very high or very low temps. [See Abstr. 2492 (1949)]. E. R.

537.226.2

6189. Anomalous behaviour of the dielectric constant of a ferromagnetic ferrite at the magnetic Curie point. BROCKMAN, F. G., DOWLING, P. H. AND STENECK, W. G. Letter in *Phys. Rev.*, **75**, 1440 (*May* 1, 1949).—Rapid changes in dielectric constant near Curie point can be explained on classical theory of variation of conductivity and permeability and do not involve considerations of coupling between electric and magnetic dipoles. N. F. A.

537.226.32

6190. High indices of refraction of barium titanate and other heteropolar titanium compounds. VAN SANTEN, J. H. AND DE BOER, F. Letter in *Nature, Lond.*, **163**, 957–8 (*June* 18, 1949).—An explanation is given of the large polarizibility of the O atoms in $BaTiO_3$. The authors calculate the energy corresponding to the transfer of an electron from a negative ion to a cation. In $BaTiO_3$ for O to Ti transitions this is 2·0 eV and for O to Ba 40·2 eV, compared with 14·4 eV for O to Mg in MgO and O to Al in α-Al_2O_3. The difference is associated with the fourth ionization energy of Ti which is 7 eV > would be expected by interpolation between other tetravalent metals.

A. L. MACK.

537.226.8

6191. The electret. GUTMANN, F. *Rev. Mod. Phys.*, **20**, 457–72 (*July*, 1948).—Substances capable of permanent electrification are classified, with details of their thermal and electrical preparation. This is a comprehensive survey, including 14 figures and 47 references of literature prior to 1946. Factors affecting the magnitude of the surface charge and the permanency of electrification are discussed. Present theories of the electret are shown to be inadequate; the author considers that Gemant's ionic theory [Abstr. 5191 (1935)] gives the best explanation for the formation of heterocharge (charge on the electret of opposite sign to the polarizing electrodes) while conduction currents in the interface between electrode and dielectric produce the homocharge (charge of the same sign as the "forming" electrodes) [Abstr. 2599 (1944)]. There is no explanation for the photo-electret. Practical applications are briefly discussed.

J. H. M.

537.226.8

6192. The present state of the physics of dielectrics. VUL, B. M. *Elektrichestvo* (*No.* 1) 3–12 (*Jan.*, 1949) *In Russian.*—A review with a bibliography of 46 references, 45 of them being Russian.

537.228.1

6193. The influence of temperature and humidity on the dielectric constant and piezo-electric modulus of Rochelle salt. I–II. KAWAI, H. *J. Phys. Soc. Japan*, **3**, 105–13 (*March–June*, 1948) *In English.*—The dielectric constant, κ_α, of α-cut crystals was measured at 1 000 c/s at temps. between 5° and 40°c and at relative humidities between 30 and 80%. The importance of allowing sufficient time in the conditioning atmosphere for stable values to be reached is stressed. Both the max. value of κ_α and the Curie temp. vary with humidity. κ_α is independent of thickness and of the method of preparation of the crystal. The piezo-electric modulus, like the dielectric constant, varies with temp. and humidity. E. R.

537.228.1

6194. Phase transition and the piezo-electric effect of KH_2PO_4. NAGAMIYA, T. AND YOMOSA, S. Letter in *J. Chem. Phys.*, **17**, 102–4 (*Jan.*, 1949).—The anomalous behaviour of the dielectric constants and the phase transition at 122°K of KH_2PO_4 were treated by Slater using statistical mechanics, but this theory does not account for the anomaly of the piezo-electric effect observed by Mason. By a modification of Slater's treatment, the authors show that Mason's results can be deduced theoretically. H. J. H. S.

537.228.1

6195. Piezo effect in barium titanate. RZHANOV, A. V. *J. Exp. Theor. Phys., USSR*, **19**, 502–6 (*June* 1949) *In Russian.*—Polycrystalline blocks of $BaTiO_3$ were polarized by the application of an electric field (optimum 25 kV/cm for 1 hr). It was found of no advantage to cool through the Curie point in the field. After some days the residual polarization was 50–80% of the initial. By static and dynamic methods values of the piezoelectric moduli d_{11} and d_{12} (stress applied, $\parallel$, and $\perp$ to, the direction of polarization respectively) were obtained which depended in stability and magnitude on the intensity and duration of the field and on the composition and treatment of the material. Results were: $d_{11} = 3{\cdot}2\times10^{-6}$ and $d_{12} = 1{\cdot}4\times10^{-6}$ e.s.u. (static); and $d_{12} = 2{\cdot}5$ to $1{\cdot}3\times10^{-6}$ e.s.u., $d_{11} \sim 2d_{12}$ (dynamic). Such polarized blocks are suitable for pickups and loudspeakers.

A. L. MACK.

ELECTRIC CONDUCTION . CURRENTS 537.

537.311.3

6196. The electric resistance of a germanium rod at low temperatures. GERRITSEN, A. N. *Physica*, **15** 427–32 (*May*, 1949) *In English.*—The resistance of a germanium rod was measured down to 1·6°K, in order to investigate whether this material is suitable for resistance thermometry in the temp. region of liquid He. The result was that the material under investigation is not very suitable for this purpose. Besides an activation energy of $5{\cdot}5\times10^{-3}$ eV, a smaller one of $0{\cdot}1\times10^{-3}$ eV appears to be of importance. A.

537.311.3

6197. Experimental studies on the electric conduction and heat capacity of cuprous sulphide semiconductors. HIRAHARA, E. *J. Phys. Soc. Japan*, **2**, 211–13 (*Nov.–Dec.*, 1947) *In English.*—Ionic conductivity is not observable in cuprous sulphide below 100°c. It reaches its max. at 440°c and then decreases rapidly. The relation between temp. and total conductivity (ionic and electronic) has discontinuities at 120° and 440°c. The specific heat was measured between room temp. and 600°c. Sharp peaks were observed at 150°c and 480°c. The anomalies appearing at the lower temp. are ascribed to a change of crystal structure, those at the higher temp. to a redistribution of S ions among the available lattice sites. H. K. H.

537.311.3

6198. The electrical conductivity of chromium sulphides. FAKIDOV, I. G. AND GRAZHDANKINA, N. F. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 1) 27–8 (1948) *In Russian.*—The Cr–S alloys belong to a series of binary alloys exhibiting ferromagnetic behaviour, in the particular case within the narrow range of atomic S-content between 53 and 55%, the max. of ferromagnetism being observed at 54%. It was established that up to 50% S the temp. coeff. of the

sistance is +ve, thus the behaviour is purely etallic, while between 50 and 53% it is that of a pical semi-conductor (−ve temp. coeff.). From 3 at. % on the alloys show again a metallic haracter of the conductivity. The 50% alloy behaves s a metal up to −40°C, the 53% alloy up to +50°C nd the ferromagnetic alloy (54% S) up to 60°C. bove these temps. the alloys remain typical semi-onductors with a negative temp. coeff. According o Joffe's theory, the causes of these phenomena ust be identical with those of the similar behaviour f PbS, although the latter does not exhibit ferro-agnetism. B. F. K.

537.311.33

199. Electrical properties of pure silicon and licon alloys containing boron and phosphorus. EARSON, G. L. AND BARDEEN, J. *Phys. Rev.*, **75**, 5–83 (*March*, 1949).—Measurements of elec-ical resistivity and Hall effect over a temp. range om 87°K to 900°K are described. Pure Si and alloys ntaining from 0·0005 to 1% of B (*p*-type impurity) r P (*n*-type impurity) were used. X-ray measure-ents showed that the impurity centres occupy ttice positions. The width of the forbidden band as found to be 1·12 eV. The activation energy sociated with acceptor impurity levels is 0·08 eV r very low impurity contents, increases with increas-g impurity content and vanishes for concentrations ove 5×10^{18} centres/cm³. Activation energies sociated with donor levels are generally smaller an those of acceptor levels. At high temps. the ectronic mobility is determined by lattice scattering; low temps., scattering from ionized and neutral purity centres contribute. H. K. H.

537.311.33

200. Observations of the electrical behaviour of licon carbide contacts. MITCHELL, E. W. J. AND LLARS, R. W. *Proc. Phys. Soc. Lond. B*, **62**, 509–22 *ug.*, 1949).—The electrical behaviour of individual C contacts has been examined using probes and gh resistance electrometer circuits to measure the otential drop across a contact. Voltage-current rves were obtained and the well-known departures om Ohm's law at the contact were confirmed. ttempts were made to fit these experimental results d other data to the theoretical expressions for nnelling through an insulating film, a hypothesis hich does not appear to fit the facts very satis-ctorily. Observations were made of the effect of ating the material to high temps. in vacuo, of the roperties of a newly formed surface and of the pacitance across the barrier layer. These indicate at the "barrier" has complicated properties which re not consistent with a simple tunnelling model. n alternative model is suggested. A.

537.311.33

201. The electrical properties of bismuth oxide. ANSFIELD, R. *Proc. Phys. Soc. Lond. B*, **62**, 476–83 *ug.*, 1949).—The conductivity σ and thermo-ectric power dE/dT of Bi_2O_3 is measured over a mp. range of 680° to 150°C, and for variations of O ressures from 76 to 10^{-4} cm Hg. The results above 40°C and at atmospheric pressure are well repre-nted by the formulae $\sigma = A_1 \exp(-\alpha/2T)$ and below 340°C by $\sigma = A_2 \exp(-\alpha/T)$, in which the values of the constants A_1, A_2 and α are very similar for two different specimens. The variation of σ with O pressure above 500°C and for pressures down to 1 mm Hg obeys the formula $\sigma = k(P_{O_2})^{\frac{1}{4}}$. The thermo-electric power results may be summarized by the equation $dE/dT = a + b/T$, where a and b are constants, the positive sign of dE/dT indicating that Bi_2O_3 is a defect semiconductor. The variations of dE/dT with O pressure are $< 10\%$, except at pressures $< 10^{-3}$ cm Hg, when the sign of dE/dT changes at temps. > 550°C. Under these conditions it is suggested that Bi_2O_3 becomes an excess or intrinsic semiconductor. The results are discussed and good agreement is obtained between theory and experiment if it is assumed that normal Wagner and Schottky lattice defects become of importance at low temps. when the concentration of free electrons is small. A.

537.311.33 : 621.314.63

6202. High inverse voltage germanium rectifiers. BENZER, S. *J. Appl. Phys.*, **20**, 804–15 (*Aug.*, 1949).—Rectifying current/voltage characteristics of up to several 100 V inverse have been observed in metal Ge point-contact rectifiers. A reproducible negative differential resistance region occurs in the inverse characteristic. Certain impurities are desirable in producing h.v. material. Surface treatment, e.g. by etching, is very important. The metal used as a whisker has little effect. Increasing the force of contact increases greatly the current at l.v. but has less effect on the h.v. curve. Pronounced improvement of rectification can be effected by treatment of the contact with large currents. Variation with temp. is very marked, especially for crystals of large inverse resistance; the variation of the inverse peak with temp. indicates that contact heating is responsible for the negative resistance. Time lags in the inverse negative resistance region of the order of 10^{-5} sec occur. When contact is made between two Ge crystals, typical inverse characteristics are observed in both directions. Photoelectric effects are observed indicating that the barrier thickness is greater the higher the inverse peak voltage. A.

537.312.5

6203. Vapour pressure of the caesium oxide photo-cathode. SAYAMA, Y. *J. Phys. Soc. Japan*, **1**, 13–17 (*July–Dec.*, 1946) *In English.*—The photoelectric emission and thermionic emission of the caesium oxide photo layer were measured as functions of the vapour pressure of Cs. The thermionic emission and photo-sensitivity were maximum for the same coverage and the vapour pressure sharply increases at the same point. The physical state of the surface is discussed. A. H. W. B.

537.312.5

6204. A method of investigating the microstructure of photocathodes by means of the electron microscope. FRIMER, A. I. AND SINITSKAYA, I. G. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 1) 49–51 (1949) *In Russian.*—The photocathode was prepared in high vacuum, its sensitivity was measured and quartz was evaporated on to its surface. The author then cut the glass envelope open, dissolved the cathode backing in acid, floated the quartz replica on to a grid and examined

it in an electron microscope, a resolution of 100 Å being attained. O/Cs and Sb/Cs cathodes were studied and their surfaces were found to be quite different from those of the base materials. High sensitivity cathodes showed wrinkles of 200–600 Å which were more regular than those on lower sensitivity cathodes. The relief on O/Cs was more marked when formed in oxidized Cs and Ag vapours. For Sb/Cs the relief developed at an early and definite stage in the formation of the cathode.

A. L. MACK.

537.312.5

6205. Photoelectric properties of alkali halogen crystals with colloids. TARJÁN, I. *Z. Phys.*, **125** (*Nos* 7–10) 497–504 (1949) *In German.*—NaCl crystals with colloids, which still show the characteristic max. of atomic centres, have been proved to have an initial spectral distribution of photoelectric conductivity. If the crystal is short circuited and irradiated with infrared energy, the spectral distribution is altered. Illumination with blue light does not return the distribution curve to the initial position which is a characteristic of atomically coloured crystals. The same phenomenon is observed also in NaCl crystals which have been discoloured by irradiation with Röntgen-rays. Such crystals also show a formation of colloids. W. S.

537.312.5 : 535.215.2

6206. Some semimetallic characteristics of the photoelectric emission from As, Sb, and Bi. APKER, L., TAFT, E. AND DICKEY, J. *Phys. Rev.*, **76**, 270–2 (*July* 15, 1949).—Spectral and energy distributions were determined for photoelectrons from crystalline evaporated layers of As, Sb and Bi. The relative numbers of electrons ejected from states near the Fermi level were obtained by the method of interchangeable emitters. In each case, the result was several times $<$ that expected for a simple metal. Structure was observed in the energy distribution function $N(v, E)$ for Sb. These effects were attributed qualitatively to an overlapping of energy bands like that assumed in the conventional model for semimetals. Data could be analysed conveniently with the aid of the function $N(v, E)/E$ previously applied to semi-conductors. Spectral distributions, relatively insensitive in form to deviations from metallic behaviour, could be fitted by Fowler plots. Work functions so determined differed by less than 0·1 eV from the following values derived from energy measurements: As, 4·72; Sb, 4·60; Bi, 4·34 eV. A.

537.312.5 : 535.215.4

6207. The optical theory of the spectral sensitivity of caesium-oxide photocathode. SAYAMA, Y. *J. Phys. Soc. Japan*, **2**, 103–7 (*Sept.–Oct.*, 1947) *In English.*—The spectral sensitivity of a semi-transparent caesium-oxide cathode (type: glass–Ag, Cs_2O, Cs–Ag) shows a maximum sensitivity in the luminous range. A Cs_2O layer containing no Ag particles has no significant absorption in the luminous range, but a thin Ag film has. The selective maximum sensitivity is due to the volume photoelectric effect. Theoretical calculations have shown the absorption of, and sensitivity to, light as being in good qualitative agreement and to be proved by experiments. The optical and photoelectric properties of the cathod are determined by the characteristics of the Ag in th layer. The quantum-mechanical treatment of th phenomenon is advocated in order to achieve mor accurate results. W. S

537.312.5 : 535.215.

6208. The optical theory of the spectral sensitivit of a caesium oxide photo-cathode. SAYAMA, Y *J. Opt. Soc. Amer.*, **39**, 162–6 (*Feb.*, 1949).—Th maximum of the spectral sensitivity of caesium oxide Ag photo-cathodes is shown to be due to the volum photoelectric effect. The long wave threshold is a about 12 340 Å corresponding to a work function c 1 eV and this as well as the wavelengths at whic max. sensitivity is observed corresponds with th optical behaviour of a thin Ag film. The photo electric characteristics of a caesium oxide cathod are determined by the optical characteristics of th thin Ag film and the photoelectrons are considered t be released from the Ag atom. W.

537.312.5 : 621.38

6209. Photo-resistances. KOLOMIETS, B. T. *Elek trichestvo* (*No.* 3) 57–62 (*March*, 1949) *In Russian.*— After a short description of the internal photo-effec and of the characteristics of known photo-resistiv materials such as Tl_2S, a survey of improved moder photo-sensitive combinations, namely, PbS, PbS CdS, CdSe, CdTe and Bi_2S_2 is given. Their sensitivit to wavelength of light with applied voltage is plotte and their frequency characteristics (for sound-filt work) and inertia properties are described. A biblio graphy of 20 items is appended. A.

537.312.5 : 621.383.4 : 535.247

The detection of small luminous fluxes. *See Abst* 6063

537.312.6

6210. Superconductors in alternating magnetic field WEBBER, R. T., REYNOLDS, J. M. AND MCGUIRE, T. *Phys. Rev.*, **76**, 293–5 (*July* 15, 1949).—A simp technique of determining the superconductin transitions of small and irregularly shaped sample of superconducting material is applied to the dete mination of the transitions and critical magnet field curves of Sn and V. The zero-field transitio and critical field curve for Sn agree well with previou determinations. The V was found to have broa transitions in zero magnetic field and critical fie slopes of over 4 000 gauss per degree. The critic field curve of the V was verified by measuremen with a susceptibility balance.

537.32

6211. Anomalous variation of the thermo-e.m.f. Ni–Mn alloys in a magnetic field. ANNAEV, R. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 6) 639–40 (194 *In Russian.*—The longitudinal and transverse Thom son effect was studied in Ni–Mn alloys. Th specimens, fused of electrolytic Ni and Mn in a h furnace and cast in porcelain tubes as moulds, had length of 40 to 180 mm and diameters of 2–4 mm but for uniformity of the strength properties we later given a standard length (40 mm) and di (2·6 mm). The effect was measured in a compensate circuit, the cold end of the Cu–Ni–Mn–Cu therm couple being kept at 5°C, the hot junction bei

ated up to 220°c. The observations of the effect n pure Ni and on the alloy of 5 atomic % Mn reed perfectly with the second law of Akulov f. Akulov, "*Ferromagnetism*," Moscow, 1939), hereas in the other cases anomalies were observed hown on 3 graphs). These may be explained eoretically by considering higher terms in the series pressing Akulov's 2nd law, and physically by the currence of a para-process. B. F. K.

537.323

212. The Fermi gas model applied to the thermal ectromotive forces of tin, lead, and indium. PIMENTEL, . C. AND SHELINE, R. K. *J. Chem. Phys.*, **17**, 4–7 (*July*, 1949).—The absolute thermoelectric owers of Sn, Pb and In in the range of 2–10°K e taken from data of Keesom and Matthijs. The mp. dependence of thermal e.m.f. is parabolic, as edicted for a Fermi gas. With an additional sumption regarding a mean free path parameter .e. $d(\log l)/d\varepsilon \ll 1$), the Fermi energies for Sn, Pb nd In are calculated to be 5·72, 2·89 and 1·20 eV, spectively. Low temp. specific heat data then ovide an estimate of the number of conduction ectrons per atom. The latter values are 2·54, 2·39 nd 0·50, respectively. A.

ELECTRIC DISCHARGES 537.52

537.52 : 621.316.54 : 545.82

Synchronous switches for electric spark generators. *ee Abstr.* 6539

537.523

213. Steam in the ring discharge. FINCH, G. I. *roc. Phys. Soc. Lond. A*, **62**, 465–82 (*Aug.*, 1949); *id., B*, **62**, 533–50 (*Sept.*, 1949).—The behaviour f steam and its decomposition products in the ng discharge has been examined. Dry H is not ssociated. The production of atomic H is dependent pon the presence of steam which dissociates into H and atomic H. A secondary source of atomic H then afforded by the interaction of OH with olecular H. The escape from the discharge of tomic H, a long-lived species, favours the dis- ociation of steam. Hg vapour, on the other hand, hibits the formation of atomic H and thus leads a high equilibrium steam concentration. Unlike y H, dry O is dissociated into atoms, but these ave a short life as such and recombine in the dis- harge to form molecular O and O_3. The reaction echanisms occurring in the discharge are discussed the light of spectrographic results. A.

537.523

214. The characteristics of short discharges. ETHERCOT, W. AND BRUCE, C. E. R. *Rep. Brit. lect. Allied Industr. Res. Ass.* (*Ref. L/T205*) 15 *pp.* 948).—The report shows how the gap voltages aries with the current when an 0·02 μF capacitor, harged to approx. 5 kV, is impressed across a gap f width 0·92 mm between 0·25 in steel balls in ries with a resistance varying from 50 to 50 000 Ω. his gave peak currents in the discharge lying between 00 and 0·1 A. In addition tests were made with an inductance in series, in order to obtain an oscillatory discharge and so to allow the phenomena occurring around current zero to be investigated. A.

537.523/.527

6215. Physics of electrical discharges in gases and in high vacuum. KAPTSOV, N. A. *Elektrichestvo* (*No.* 1) 17–32 (*Jan.*, 1949) *In Russian.*—A general review of the basic physical processes underlying the operation of discharge-tubes. Topics discussed include: the mechanism of electron-emission from solids, collision-processes in gases, the avalanche discharge and conditions in the plasma. A. SCH.

537.523.3

6216. Point-to-plane corona onsets. ENGLISH, W. N. AND LOEB, L. B. *J. Appl. Phys.*, **20**, 707–11 (*July*, 1949).—The effect of point material and point radius of curvature on positive and negative intermittent corona onset potentials has been studied with a point-to-plane gap in air at atmospheric pressure. The negative Trichel pulse onset is independent of point material but does depend on point history and radius. This surprising result is shown to come from the circumstance that the Trichel pulse onset depends on current densities needed to condition the point surface and yield a higher value of the second Townsend coeff. to give the increased currents. Trichel pulse onset thus does not mark the onset of a self-sustaining discharge. The self-sustaining discharge initiates at lower potentials and leads to currents of a low order until the cathode spot cleans up. A.

537.523.4

6217. The influence of electric fields on the extinction of electric sparks. YADOFF, O. *C.R. Acad. Sci., Paris*, **223**, 74–5 (*July* 8, 1946) *In French.*—Using spark gaps, between points, of 10 cm the effect of radial electrostatic fields on the discharges was examined. Fields equivalent to ~264 kV applied between the spark channels and a surrounding cylinder some 12 cm in radius were sufficient to inhibit 51 kV sparks. No discussion of the results is given. J. D. C.

537.523.4 : 537.525.4

6218. On sparking potentials. KOBAYASI, T. *J. Phys. Soc. Japan*, **2**, 75–80 (*July–Aug.*, 1947) *In English.*—From a consideration of the field distribution in sphere gaps (sphere dias. 5–25 cm) and the known spark breakdown characteristics of such gaps, it is concluded that breakdown occurs when the electric field at about 1 cm from the electrode surface ~30 kV/cm. This is for sparks in air at 1 atmos. The conclusions are modified for shorter gaps. Measurements of low pressure breakdown voltages in air are quoted in detail, and an empirical formula connecting breakdown voltage and pressure is derived, which covers the pressure range 300–600 mm Hg. J. D. C.

537.523.5

6219. Electron-optical phenomena in the plasma of the mercury arc at a low pressure. GOLIK, L. I. AND SPIVAK, G. B. *J. Tech. Phys. USSR*, **19**, 839–48 (*July*, 1949) *In Russian.*—It is shown that in the field of a magnetic lens acting on a stationary plasma, contractions of two types occur: (1) a diffuse plasma

contraction; (2) an electron-optical one. The second case occurs where there is a potential jump or an artificial constriction in the plasma. The distribution of charges along the radius of the beam was measured and the influence of the field of the second magnetic lens concentrating the beam was explained. The value of the discharge current influences the focusing as well as all the other effects of the magnetic field. The reduction of the contraction with increasing current is due to the increase of the ratio of the velocity of the random electron movement as against that of the directed movement. B. F. K.

537.523.5

6220. The vaporization of the cathode in the electric arc. HOLM, R. *J. Appl. Phys.*, **20,** 715–16 (*July*, 1949).—Calculations are carried out which show that, because of the smallness of the cathode spot, the cathode is not able to dissipate the heat generated with heavy currents by conduction. Therefore, a much higher vaporization of cathode material per coulomb occurs for heavy currents than for low currents. A.

537.525

6221. On the maximum of current in the intermittent functioning of discharge tubes. MOUSSIEGT, J. *C.R. Acad. Sci., Paris*, **222,** 1479–80 (*June* 24, 1946) *In French.*—For previous work see *C.R. Acad. Sci., Paris*, **222,** 1280 (1946). A capacitor, C, is in parallel with the discharge tube, and the influence of this on the current is studied. The max. current is calculated for small and for large values of C. L. S. G.

537.525

6222. Radiative processes in thermionically controlled discharges in helium. FOWLER, R. G. AND DUFFENDACK, O. S. *Phys. Rev.*, **76,** 81–9 (*July* 1, 1949).—Recent measurements have been made of the intensity of radiation from the low voltage arc in He as a function of gas density, tube current and tube potential. The experimental results indicate that the radiation is the result of a primary electron process. This process has been generally assumed to be direct excitation. Such an explanation is not fully in accord with the phenomena observed. The possibility of an unrecognized process is suggested. A.

537.525.3

6223. Decrease of an electrical discharge by external radiation. PARSHAD, R. AND KARIM, S. Letter in *J. Chem. Phys.*, **17,** 667–8 (*July*, 1949).—This brief note describes the diminution of current in a discharge (a.c.) through dry air at 0·7 mm Hg pressure, when radiation from an incandescent lamp was allowed to fall on the discharge space. J. D. C.

537.525.3

6224. Production of the Joshi effect in mercury vapour. PRASAD, B. N. Letter in *Nature, Lond.*, **164,** 69–70 (*July* 9, 1949).—Describes experiments on the photo-diminution or Joshi effect [see Abstr. 1786, 2049, 2566 (1944), etc.] in a Siemens' ozonizer tube containing Hg vapour. J. D. C.

537.525.3

6225. Influence of exciting potential, gas pressure, frequency of a.c. supply and light intensity on the Joshi effect in chlorine under full ozoniser and semi-ozoniser excitation. RAO, D. V. R. AND SARMA, B. K. *J. Phys. Coll. Chem.*, **53,** 753–68 (*June*, 1949).—Gives the results of a detailed investigation of th effects of various parameters on the Joshi effect in C The effect is not fully explained. Positive an negative Joshi effects were observed and were foun in general to be smaller at higher pressures, althoug maxima often occur at low pressures. The trend the variation of Joshi effect with current is somewha similar. J. D.

537.525

6226. The figures on the surface of metal electrod produced by the breakdown in high vacuum. HASH MOTO, K. *J. Phys. Soc. Japan*, **2,** 71–5 (*July–Aug* 1947) *In English.*—Breakdown-voltage/gap-spacin curves are given for point/plane gaps in high vacuu tubes. Tube pressures varied from $4 \cdot 5 \times 10^{-6}$ up 7×10^{-5} mm Hg, using a wax sealing techniqu Voltages up to 100 kV were used, with gap spacin varying from about 0·5 to 2·5 mm. The appearanc of the plane electrodes, and the etched figur appearing thereon are described. No detailed explana tion of their formation appears possible at present. J. D.

537.525.5 : 535.338.33

Spectrum of positive column of Na vapour lam *See Abstr.* 6088

537.525

6227. The role of the cathode in discharge instabilit LOEB, L. B. *Phys. Rev.*, **76,** 255–9 (*July* 15, 1949).— It is shown that a highly stressed conditioned cathod in a gas will, by positive space charge action, produc an autocatalytic increase in current through a cha reaction leading to complete breakdown. Dependin on conditions in the circuit this common tendenc will explain a number of phenomena. In pure fre electron gases, the discharge has a negative chara teristic and must be controlled by external resistanc or else lead to an arc. In the presence of adequa low field regions and moderate negative ion forma tion, a current controlled by the internal space charg resistance of the system results. Where negative ic formation is heavy and low field regions exist, th discharge will choke itself off and be intermitten In cases where there are large electrically elast columns of ionized gas at lower pressure that can b swept by ionizing potential waves, as in glow di charges, the cathode instability leads to pulsations moving striations and is the cause of setting up an sustaining plasma oscillations. Among the cons quences of such action where intermittent or pulse discharges occur, there will be a Faraday dark spac and perhaps striations. Faraday dark spaces wi occur only where cathode instabilities cause curre fluctuations and should not be observed in mo stable discharges.

537.525

6228. Discharges excited by microwaves. ROBER SON, J. K., KENNEY, J. R. AND NIXON, W. C. Letter *Nature, Lond.*, **164,** 100–1 (*July* 16, 1949).—Describe the light emission from discharges produced various gases by 3·2 cm waves (0·75 microsec pulse fed into the discharge tubes through a waveguid A Tesla discharge was used to initiate current flo Experiments were made in air (0·3–67 mm Hg), N

g vapour, Ne, A and He. Some observations on terglows were made with a stroboscopic device.
J. D. C.

537.525.8 : 535.33 : 534.222.2

29. Ultra-violet spectra of highly condensed discharges: comparison with the luminosity produced by ock-waves. MURAOUR, H., ROMAND, J. AND DDAR, B. *C.R. Acad. Sci., Paris*, **223**, 620–2 *ct.* 21, 1946) *In French.*

537.525.8

30. Running striations and multiple electron temratures. OLESON, N. L. AND FOUND, C. G. Letter *J. Appl. Phys.*, **20**, 416–17 (*April*, 1949).—Probe udies with a discharge in 7 mm Hg of spectroopically pure A plus Hg vapour showed that without riations the electron energy distribution was Maxellian ($T_e = 8\,900$°K at 0·4 A, 74·5 V, 40°C). ith running striations and nearly the same electrical nditions, probe characteristics indicated two groups electrons ($T_e = 6\,050$ and $15\,400$°K). J. D. C.

537.527

31. High-pressure rare-gas discharges. ELENAS, W. *Philips Res. Rep.*, **4**, 221–31 (*June*, 49).—The light output, the total radiation and e electrical gradient have been measured for A, Kr d Xe high-pressure discharges of the wall-stabilized pe. The characteristics of these discharges have en calculated, assuming the discharges to be in temp. uilibrium and the radiation to be mainly a recomnation continuum. The light output, the total diation and the electrical gradient have been derived, suming a constant energy per unit of frequency (as lculated by Unsöld) in the frequency band from o $\nu_m = eV_i/h$. In the calculation of the electrical adient the influence of the positive ions on the bility of the electrons has to be considered. The luence of the atoms and that of the positive ions ve been experimentally separated, and the magude of both has been found in accordance with the lculations. A.

537.529

32. The mechanism of discharges in voids in lectrics. Interim report. MASON, J. H. *Rep. Brit. ect. Allied Industr. Res. Ass.* (*Ref.* L/T192) 19 *pp.* 948).—An experimental investigation of the electric ess necessary for inception of discharges in small ids in polythene has been undertaken and preinary results are given in this report. The variation inception stress with the depth and area of the voids, e effect of surface contamination, and the magnitude discharge at inception have been determined. The gnitude and frequency of discharge have been served to vary with the voltage applied, the period test, and the dimensions of the void. Results e presented for discharges between plane-parallel lythene surfaces, and between polythene and a planerallel metal electrode. A.

537.529

33. Electrical breakdown of organic insulation by ctro-chemical reactions. CHURCH, H. F. AND RTON, C. G. Letter in *Nature, Lond.*, **162**, 301 *ug.* 21, 1948).—The authors claim that preferential nbination of the cathodically produced H with small quantities of added compounds called stabilizers, shields the impregnated cellulosic materials from attack in capacitors under moderate d.c. stress. Previously these added compounds have been thought to function by the production of a protective film at the electrodes or a co-ordination complex between the stabilizer and aluminium chloride formed during deterioration. I. W. A. K.

X-RAYS 537.531

537.531

6234. On the formation of images with X-rays. Possibility of making magnifying glasses and microscopes by the aid of crystals. CAUCHOIS, Y. *C.R. Acad. Sci., Paris*, **223**, 82–4 (*July* 8, 1946) *In French.*—Real images of objects placed between the focus and a bent crystal lamina are formed by reflection of the X-rays on planes nearly normal to the lamina. Several photographs are reproduced. A. J. C. W.

537.531 : 535.33

6235. Discussion of "geometrical factors affecting X-ray spectrometer maxima." SPENCER, R. C. Letter in *J. Appl. Phys.*, **20**, 413–14 (*April*, 1949).—The author claims that his previous general treatment [*Phys. Rev.*, **38**, 618–29 (1931)] of the effects of apparatus on recorded curves contains the principles applicable to the case treated by Alexander [Abstr. 1053 (1949)]. The various parts introduce independent divergencies, whose 1st, 2nd and 3rd moments combine additively. The moments of the separate divergencies can be chosen to reduce the overall moments. S. M.

537.531 : 535.333

6236. Study of X-rays emitted from gases. GROVEN, L. *Ann. Phys., Paris* (*Sér.* 12) **4**, 62–104 (*Jan.–Feb.*, 1949) *In French.*—The X-ray spectra of rarefied gases excited by high frequency discharges are investigated by means of a Cauchois spectrograph using a bent crystal. The wavelengths of the line series of the vapours of Cu, Zn, Ga, Ge, As are compared with similar data obtained by other workers on solids and some new satellites have been observed. The subject of X-ray excitation of gases is reviewed in detail. R. H. H.

537.531 : 535.34

6237. Absorbability of heterogeneous scattered X-rays. PAL, H. K. *Indian J. Phys.*, **23**, 111–18 (*March*, 1949).—The absorbability X_φ of a heterogeneous beam of scattered X-rays in direction ϕ has been compared to X_{90} for different scatterers and for different primary radiations. In the region of backward scattering, $X_\varphi > X_{90}$ invariably, as required by the Compton theory of scattering for homogeneous radiation. The agreement is of the right order of magnitude. In the forward direction, the experimental results may be classified under the following 3 distinct types, depending on the average wavelength of the primary beam and the nature of the scattering material. (*a*) $X_\varphi < X_{90}$, (*b*) $X_\varphi = X_{90}$, and (*c*) superficially appearing to contradict the Compton theory. An interpretation

on the basis of the Compton theory of this anomaly has been attempted. A.

537.531 : 535.343

6238. Absorption of X-rays in air. DAY, F. H. AND TAYLOR, L. S. *Radiology*, **52**, 239–47 (*Feb.*, 1949).—Precision absorption measurements on voltages from 7·5 to 200 kV const. potential with varying filters are described. A large ionization chamber embracing the whole of a narrow beam of X-rays is moved along its path, and the absorption is deduced by relating to inverse square law. Large variations occur with filtration and the results are shown graphically for filters of 0 to 6 mm Al. F. T. F.

537.531 : 535.4 : 548.735

6239. X-ray diffraction by randomly oriented line gratings. JONES, R. C. *Acta Cryst.*, **2**, 252–7 (*Aug.*, 1949) *In English.*—A line grating is defined as a periodic linear structure, most generally represented by a chain of similarly oriented and uniformly separated unit cells arranged along a straight line. The calculations assume that the line gratings are also randomly positioned in space, and that the number N of unit cells in each of the line gratings is the same. The corresponding result for a distribution of lengths among the line gratings, however, may be obtained by suitably averaging the result given. The calculated pattern is compared with the corresponding patterns for ordinary 3-dimensional crystals and for 2-dimensional arrays, and it is shown that the pattern for the 2-dimensional arrays represents a combination of the properties of the patterns for line gratings and 3-dimensional crystals. A typical intensity distribution is shown, and it is found that, even for large values of N, the pattern shows a smooth distribution of diffracted intensity, except for sudden changes in the intensity at the angles which would correspond to the position of the $h00$ lines in a simple cubic lattice with the same separation between adjacent unit cells. A.

537.531 : 537.542

The efficiency of Geiger–Mueller counters for X-ray intensity measurements. *See Abstr.* 6271

537.531 : 778.33

Possible industrial application of soft X-radiation 15–100 kilovolts. *See Abstr.* 6670

537.531.08

6240. Apparatus for automatic recording of variations of intensity of radiation, and of the time-integral of the intensity. MALLETT, L. AND MAURIN, R. *C.R. Acad. Sci., Paris*, **223**, 283–4 (*Aug.* 5, 1946) *In French.*—Two Geiger chambers are used, the central wires of each being in electrical contact. The outer cover of one is earthed and coated with radio-active material. The other chamber is exposed to the radiation, and its outer cover maintained at a constant potential. Variations in the radiation intensity cause variations in the potential of the central wire; this potential is measured by an ordinary recording electrometer. To adapt for integrating, the central wire of the chamber exposed to the radiation is attached to a condenser; the charge acquired by this condenser is a measure of the total ionization current which has flowed in the given time, and hence of the integrated radiation intensity. N. C.

537.531.08 : 537.5

Geiger counters for soft X-rays. *See Abstr.* 6272

CATHODE RAYS . POSITIVE RAYS 537.533/.5

537.5

6241. On the electrostatics of electron beams circular section. BORGNIS, F. *Ann. Phys., Lp (Folge* 6) **43** (*No.* 8) 616–29 (1943) *In German.* Poisson's equation, satisfied by the potential, ϕ, every point within the beam, is solved by expressi ϕ as a Fourier series, with coeffs. which are functio of the distance from the axis. These coeffs. a expressed in terms of Bessel functions. A numb of particular cases are discussed, including (1) t potential and field distribution for a space char distribution of constant density, (2) the space char cylinder in the interior of a metal circular cylinder. L. S.

537.533 : 538.569.4 : 621.38

6242. A travelling wave linear accelerator with power feedback, and an observation of r.f. absorpti by gas in presence of a magnetic field. SHERSE HARVIE, R. B. R. AND MULLETT, L. B. Letter *Proc. Phys. Soc., Lond. B*, **62**, 270–1 (*April* 1, 1949). Power is fed back from the output end of a travellir wave linear electron accelerator and combined w that from the source in a bridge circuit, instead being dissipated in a dummy load; this enables t accelerator to be less than optimum length withc loss of efficiency. During an experimental test the method, high r.f. power loss was observed in t accelerator in the presence of a magnetic field; t effect disappeared with lower gas pressure. T. G.

537.533 : 615.8

The synchrotron accelerator. *See Abstr.* 6641

537.533 : 621.3

6243. Electron emission and stationary electron flo MAYER, H. *FIAT Rev. German Sci.* (1939–46) [*C Mil. Govt. Germany*] *Pt I*, 1–19 (1948) *In German* Deals with the external photoelectric effect. Pt metals are first discussed and then prepared filr Some new methods of measurement are indicat New techniques for construction and surface prepa tion are described. A useful bibliography of references is given. A. H. W. B.

537.533 : 621.38

6244. The microwave linear electron accelerat NEWBERRY, G. R. *Brit. J. Radiol.*, **22**, 473–86 (*Au* 1949).—The present interest in linear accelerators nuclear physics and medical use, which has ari from the development of microwave valves and wa guide techniques during the war, is reviewed, and various types of microwave linear accelerator briefly described. The operation of travelling-wa standing-wave and multi-cavity accelerators is t described in detail. The theoretical and practi limitations of the performance of each type accelerator at a design frequency of 3 000 M (10 cm wavelength) are discussed. The design linear accelerators at this frequency suitable

edical use is discussed, and tentative layouts of MeV and 10 MeV machines are given. A.

537.533 : 621.385.833

245. Notices on proposed magnetic lenses of roidal type. HORVÁTH, J. I. *Experientia*, 5 (*No.* 3) 2–14 (1949) *In English.*—By filling a toroid with dial air-spaced Fe laminae the field in the air gaps ay be made uniform. Profiles are calculated for the oss-section of the toroid to satisfy the requirement at all electrons from a point source on the axis of mmetry shall be perfectly imaged after passing in rcular paths through the air gaps. The profile is a emisphere about the source, but a more complicated gure on the image side. The effects of refraction in ie non-uniform field near the two bounding surfaces re not calculated. The application envisaged is a igh gathering power lens for β-rays. [See also bstr. 1550 (1947)]. J. C. E. J.

537.533.3

246. General properties of paraxial electron ptical image formation. BORGNIS, F. *Helv. Phys. cta*, **21**, 461–79 (*Dec.* 20, 1948) *In German.*—The nalysis is carried out on the basis of the equations f motion of paraxial electrons. A general geo- netrical proof of the validity of the Lagrange–Helmholtz theorem for electron-optics is obtained. his theorem connects the aperture with the nagnification. L. S. G.

537.533.35 : 535.39 : 621.385.833

247. Use of the electron microscope in the optical ndustry. ROBILLARD, J. *Rev. Opt.* (*Théor. Instrum.*) **8**, 129–45 (*March*, 1949) *In French.*—Describes the cetate-silica method for obtaining replicas of surfaces nd the gold-shadow technique. A number of hotographs is given showing the effects of rulings n glass and metal, corrosion and the structure of nti-reflection films. These latter show their known ranular structure. By measurement of the number nd average size of grains the fraction of volume ccupied by them (ϕ) was found. Heller's formula xpressing the index of the film (n_f) in terms of ϕ nd the index of the bulk material (n) was used to ind n_f. For $CaFl_2$ $n = 1{\cdot}32$, and n_f was found to e $1{\cdot}30$. H. H. HOP.

537.533.35 : 621.385.833

248. The illuminating system of the electron nicroscope. HILLIER, J. AND ELLIS, S. G. *J. Appl. hys.*, **20**, 700–6 (*July*, 1949).—Using a self-biased lectron gun the current arriving at the specimen, he current density at the specimen, and the area of llumination of the specimen have been determined or different values of the filament height. The ariation of current density at the specimen with ngular aperture of illumination has been determined nd the results compared with those for the zero-iased gun. The performance of the self-biased gun s assessed and some of the factors involved in its peration and maintenance are discussed. A.

537.533.35 : 621.385.833 : 621.385.1.032.216

5249. A new emission microscope for oxide cathodes. JACOB, L. *J. Sci. Instrum. Phys. Ind.*, **26**, 262–6 *Aug.*, 1949).—An emission microscope is described or investigating the point-by-point variation of emission of an oxide surface. Its action depends on the very special property exercised by the modulator of a conventional electron gun, of acting like an iris diaphragm when its potential is varied. It thus controls the area of emission on the cathode surface, and affords a means for exploring the variations which occur over small areas. The effects at both high and low modulations are examined for an extensive oxide surface and the instability associated with temp.-limited emission investigated for all points on the modulation characteristic. A.

537.533.72 : 621.385.833

6250. Illumination of objects in electron microscopes. YANCHEVSKI, K. *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 2) 127–30 (1948) *In Russian.*—The electron-optical conditions restricting illumination are discussed and it is concluded that condenser lenses cannot increase the intensity of the "illuminating" beam, because they do not alter the energy of the electrons. The magnitude of the effective source, i.e. the cross-section minimum of the beam, varies with the electrode geometry and with the ratio of the electrode potentials. This property of the radiator may be used for the choice of the cathode-object distance and also for varying the aperture of the illuminating beam. For the latter purpose it is sufficient to regulate the potential of the control electrode or its distance from the cathode. A comparative test on two electron microscopes, one with and one without condenser, showed that the simple illuminating arrangement enabled anode currents (20–30 μA) to be used such as were previously thought to be possible only in instruments with special focusing lenses. The pictures taken with these two microscopes strikingly illustrate this statement, as practically no difference can be detected (all conditions, i.e. anode potential, current and exposure time being equal). B. F. K.

537.533.73 : 548.7

6251. On the theory of Kikuchi-envelopes. ARTMANN, K. *Z. Phys.*, **125** (*Nos* 4–6) 298–335 (1948) *In German.*—A mathematical treatment based on the solution of the wave equation for an electron wave in a 3-dimensional periodic potential field. J. T.

537.533.73 : 548.74

6252. On the theory of Kikuchi-bands. ARTMANN, K. *Z. Phys.*, **125** (*Nos* 4–6) 225–49 (1948) *In German.*—A wave-mechanical treatment. It is assumed that the scattering electrons, when an electron wave falls at a glancing angle on a densely populated set of atomic planes, should be regarded as bound rather than free. J. T.

537.533.74

6253. Straggling of electrons near the critical energy. EYGES, L. *Phys. Rev.*, **76**, 264–9 (*July* 15, 1949).—The straggling of electrons caused by loss of energy by radiation and collision is discussed. The "straggling probability" for an electron that loses energy only by radiation is given, with curves corresponding to various approximations to the expression for the radiative cross-section. Collision loss is also taken into account and a formal expression for the straggling probability is found in the form of a series whose terms decrease rapidly for energies not too small and not too large thickness. No proof of

the convergence is given, however, and, in fact, for very small energies the terms increase and some higher order terms become infinite at zero energy. Some remarks are made on the small "showers" initiated by a particle of energy near the critical energy. A.

537.533.74 : 539.165

6254. Error due to scattering in measurement of cloud chamber tracks in a magnetic field. BOTHE, W. *S.B. Heidelberger Akad. Wiss.* (*Math. Naturwiss. Kl.*) (*No.* 5) 107–18 (1948) *In German.*—The problem as it arises for β-particles of moderate energy ($\sim$ 100 keV) is treated. J. G. W.

537.533.8

6255. On the liberation of ions by electron bombardment. FILOSOFO, I. AND ROSTAGNI, A. Letter in *Phys. Rev.*, **75**, 1269–70 (*April* 15, 1949).—Using a carefully designed electron gun the liberation of positive ions from a steel anode bombarded by electrons having energies $\leqslant 70$ keV was observed. The average number of positive ions liberated per electron varied up to 4×10^{-6} and in a case where oil vapour from the diffusion pump was allowed to enter and contaminate the apparatus the coeff. had a max. value of slightly more than 2×10^{-3}. J. D. C.

537.533.9

6256. On Kramers' formula for the frequency distribution of the radiation emitted by an electron in a parabolic orbit. WESTFOLD, K. C. *Phil. Mag.*, **40**, 698–703 (*July*, 1949).—It is found that the correct approximation to the frequency distribution of radiation emitted during a free-free electron-ion encounter, obtained from classical theory, leads to a formula for absorption which is equivalent to that obtained from the quantum theory, under conditions required by the correspondence principle. L. S. G.

537.533.9 : 537.226.8

6257. Electron bombardment conductivity. ANSBACHER, F. AND EHRENBERG, W. Letter in *Nature, Lond.*, **164**, 144–5 (*July* 23, 1949).—In very thin dielectric films (mica, glass, Al_2O_3, As_2O_3, Sb_2O_3) sandwiched between metal electrodes (Al or Au), when bombarded with pulsed electron beams, an electric current is observed passing between the electrodes. This current may be several thousand times the exciting beam current. Typical yields on an As_2S_3 film of $1{\cdot}6\,\mu$ thickness, were: $y = 2{\cdot}4$ at 90°K; $y = 8{\cdot}5$ at 290°K; $y = 1\,000$ at 420°K. The beam current was $0{\cdot}25\,\mu$A/cm² at 25 kV with +50 V bias. The large yield at high temps. is due to the thermal release of the trapped charges. No time lag in the rise of the secondary current has so far been observed. W. S.

537.533.92

6258. The distribution of the number of ion pairs in the clusters along the track of a fast β-particle in air and in neon. BEEKMAN, W. J. *Physica*, **15**, 327–8 (*May*, 1949) *In English.*—On making experiments with the Wilson cloud chamber about the probable and primary ionization of fast β-particles in air and Ne a large quantity of statistical material was obtained about the distribution of the number of ion pairs in the clusters along the tracks. An abstract of these data is given. A.

537.534 : 621.384

6259. Orbital stability in a proton synchrotr TWISS, R. Q. AND FRANK, N. H. *Rev. Sci. Instru* **20**, 1–17 (*Jan.*, 1949).—A discussion of the betatr and phase oscillations in the relativistic and n relativistic regions of operation with emphasis the differences between proton and electron s chrotrons. The acceptance domain in phase sp at injection is calculated as a function of the sta phase. The period and damping of the phase os lations is given as a function of the injection pha i.e. for small and large amplitudes. Initial betatr acceleration with the r.f. voltage applied slo results in improved bunching and predamping of phase oscillations. The merits of various injecti methods are discussed as to the number of partic accepted. Numerical examples throughout are bas on a 10^4 MeV machine of 24·3 m orbital radius. W. I. B.

537.53

6260. Improved magnetic focusing of charg particles. KERWIN, L. *Rev. Sci. Instrum.*, **20**, 36– (*Jan.*, 1949).—The effect of alterations to the sha of the boundaries of a symmetrical uniform magne field on the focusing action of the field on an i beam of wide divergence is considered theoretical Two cases are discussed in detail; one, the wed shaped magnetic field described by Barber a Stephens, and the other, also a wedge-shaped fie termed an inflection field. The latter has t advantage that it eliminates 2nd order aberratio The practical application of inflection field focusi to mass spectrometers is discussed and it is sho that a resolving power may be obtained of 10 tim that of the usual type of field. H. J. H.

537.534.

6261. Correlated probabilities in multiple scatterin SCOTT, W. T. *Phys. Rev.*, **76**, 212–19 (*July* 15, 1949). The correlated probabilities of lateral and angul displacements of cloud-chamber tracks, resulti from multiple small-angle scattering, have be calculated for several cases of interest. The resu are applicable to curvatures and other measuremer taken in the presence of a magnetic field. The usu Gaussian-type scattering law has been used in t form of the fundamental correlated distributi function derived by Fermi. One direct application this function is to the effect of scattering and ang measurements in nuclear "stars." A "3-poi formula" is derived, involving a correlated distributi of two successive lateral displacements with t resultant angular displacement. The distribution scattering-produced curvatures, originally derived Bethe, is calculated. A "4-point formula" allo a quantitative discussion of the tendency of scatter tracks to appear circular rather than skewed S-shaped. Finally, a formula is derived for t distribution of the successive chord angles for a tra observed at several points, and used to discuss t best method of averaging the observations to redu scattering-produced curvature errors. The err produced by scattering is not appreciably diminish by taking the best mean for an observation of t track at a large number of points, instead of a sing observation of chord and sagitta (3 points).

537.534.74

62. **Multiple scattering of fast charged particles.** YDER, H. S. AND SCOTT, W. T. *Phys. Rev.*, **76**, 0-5 (*July* 15, 1949).—The theory of multiple attering of charged particles has been extended in e small-angle approximation valid for thin foils d fast particles. The extension consists of an exact lution of the integral diffusion equation for the rrelated probabilities of lateral and angular dis-acements, and the numerical integration of the sulting expression for the angular distribution. The ojection of the scattering on a plane has been used r simplicity. The results are expressed in terms of mensionless variables η/η_0 and z/λ representing spectively the deflection angle in terms of a small it determined by the screening, and the foil thick-ss in terms of the mean free path for scattering. umerical calculations for values of z/λ from 100 84 000, and for an adequate range of η/η_0, have en carried out, and tables have been made available. urves are presented for a few values of z/λ. The atching is shown between the approximately aussian result for small angles and the Rutherford ngle scattering result valid for large angles. The viations of the new results from each of these niting values is quite large over a wide range of ngle. An explicit asymptotic formula for large η given, showing correction terms to the single attering formula. A.

537.534.74

63. **Resonance scattering of protons by aluminum.** ENDER, R. S., SHOEMAKER, F. C., KAUFMANN, S. G. ND BOURICIUS, G. M. B. *Phys. Rev.*, **76**, 273–6 *uly* 15, 1949).—The elastic scattering of protons by l at energies near the 985 keV [based on the 440 keV (p,γ) voltage scale] resonance has been studied, with e use of the homogeneous proton beam available om the Wisconsin pressure generator equipped with e 90° electrostatic analyser. The variation in the attering yield with proton energy agrees quali-tively with the prediction of the Breit–Wigner rmula. On the assumption of *S*-scattering, the ta indicate a natural resonance width of the order 100 V. A.

DISCHARGE TUBES . COUNTERS 537.54

537.542

64. **Notes on the production of Geiger–Mueller unters and the discharge mechanism.** HASHIMOTO, . *J. Phys. Soc. Japan*, **3**, 153–6 (*March–June*, 48) *In English.*—The effect on Geiger counter aracteristics of altering the A/alcohol ratio for the ling, for a given total pressure, is described. Then e importance of the design of filling systems in der to give the same composition of filling (when or more gases are in use) in different counters is monstrated. Finally a brief discussion of the iger counter discharge mechanism is given, which ds to the approximate calculation of starting tentials. J. D. C.

537.542

6265. **Idea and design of wire-and-plate type counter.** HASHIMOTO, K. *J. Phys. Soc. Japan*, **3**, 151–3 (*March–June*, 1948) *In English.*—The construction and characteristics of plate/wire/plate counters are described. The wires, 3 or 5 in number, are mounted transversely across the length of the plates. With air/alcohol fillings, good plateaus were obtainable although, in the present preliminary designs, there is some interaction between the discharges on the different wires. J. D. C.

537.542

6266. **Discharge of a Geiger counter at voltages above the plateau.** CRANE, H. R. Letter in *Phys. Rev.*, **75**, 985 (*March* 15, 1949).—Expts. on the average time elapsing between the sudden raising of the voltage on a Geiger counter and the first discharge suggest that after-emission of electrons or photons may be responsible for spurious discharges. The results given were taken with an A/alcohol filling, brass cathode and W wire anode. J. D. C.

537.542

6267. **High multiplication proportional counters for energy measurements.** HANNA, G. C., KIRKWOOD, D. H. W. AND PONTECORVO, B. Letter in *Phys. Rev.*, **75**, 985–6 (*March* 15, 1949).—Describes expts. with proportional counters filled with Xe/CH_4, $Xe/A/CH_4$, or A/CH_4 on the decay of A^{37} (giving X-ray lines at 2·8 keV and $\sim$250 eV) and on the use of Mo K α-radiation (17·4 keV) for calibration purposes. A 30-channel pulse analyser is used. Diagrams showing the peaks in the above simple spectra are given, with a discussion of apparent line widths, etc. J. D. C.

537.542

6268. **Delayed emission of electrons from the cathode in a counter when operated above the plateau.** WIEDENBECK, M. L. AND CRANE, H. R. Letter in *Phys. Rev.*, **75**, 1268 (*April* 15, 1949).—Describes expts. with a two-cylinder Geiger counter, which show that spurious counts can be caused by delayed emission of electrons from a cathode activated by a previous discharge. The cathode under test was first activated by rapid counting and was then slid along, inside the same containing tube, and used with another wire. The delayed emission for Al was appreciably higher than for Pb or brass. J. D. C.

537.542

6269. **Characteristics of halogen counters.** LIEBSON, S. H. *Rev. Sci. Instrum.*, **20**, 483–4 (*July*, 1949).—Some characteristics of halogen counters have been obtained which enable their preparation for given operating voltages. Other factors influencing their behaviour are discussed with a view toward obtaining optimum results. A.

537.542

6270. **A demountable Geiger–Muller counter using filling gases at atmospheric pressure.** TAIT, J. F. AND HAGGIS, G. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 269–71 (*Aug.*, 1949).—A simple demountable counter is described suitable for the assay of tracers emitting low energy β-rays. Satisfactory characteristics have been obtained with a He-ether mixture flowing through

the counter at atmospheric pressure. Using this mixture, the counter has a plateau length of 400 V, a plateau slope of 0·01%/V and a threshold potential of approx. 3 250 V. A comparison is made with other methods which have been used for the assay of C^{14} and a table is included showing their relative sensitivity. A.

537.542 : 537.531

6271. On the photo-electric quantum efficiency of Geiger–Mueller counters for X-ray intensity measurements. HASHIMOTO, K. *J. Phys. Soc. Japan*, **1**, 26–9 (*July–Dec.*, 1946) *In English.*—The quantum efficiency of G.-M. counters for characteristic X-rays of $Fe_{K\alpha}$, $Cu_{K\alpha}$, and for $Mo_{K\alpha}$ has been determined from the ratio of the number of counts and the calculated number of quanta absorbed in the gas of the counter. The experiment has been carried out (*a*) with the X-ray beam passing only through the gas of the counter and (*b*) passing through the gas and striking the cathode metal. In the latter case an increase of quantum efficiency was expected. This increase has, however, been shown to be negligible. R. H. H.

537.542 : 537.531.08

6272. Geiger counters for soft X-rays. BROGREN, G. *Ark. Mat. Astr. Fys.*, **36 A** (*Paper* 18) 1–10 (1949) *In English.*—To improve the sensitivity of counters for X-rays 1 000–5 000 X.U. experiments have been made with tubes filled with Kr or Xe and ethyl ether or amyl acetate or $Pb(CH_3)_4$ instead of A and alcohol. It is suggested that the effect [Abstr. 1888 (1947)] was due to distributed capacities between pentode grid and earth and that the characteristics of the new counters in the Neher–Harper circuit are practically independent of the pentode grid bias, within normal limits. T. A. C.

537.542 : 539.16.08

6273. An internal Geiger counter for the assay of low specific activity samples of carbon 14 and other weak beta emitters in biological samples. KELSEY, F. E. *Science*, **109**, 566–7 (*June* 3, 1949).—Describes a windowless Geiger tube of the continuous gas flow type, in which the active sample is enclosed. The plateau has $< 4\%$ rise/100 V from 1 350–1 550 V and the background, behind 2 in Pb, was 28/min at 1 375 V. With a sensitive area of 10 cm² (20 cm² available) 10 mgm barium carbonate containing 5×10^{-4} microcurie C^{14} gave a counting rate of 564/min at 1 375 V. J. D. C.

537.542 : 539.16.08

6274. The construction and performance of a high pressure condenser ionization chamber. SPIERS, F. W. *Brit. J. Radiol.*, **22**, 169–72 (*March*, 1949).—The steel-walled chamber described will measure weak γ-radiation, about 2 μgrms of Ra at 50 cm producing a reading equal to background activity. The construction ensures that leakage of the filling gas (N at 78 atmospheres) is very small. Measurements are made with a Lindemann electrometer. Diagrams show the variation of chamber characteristics and sensitivity with gas pressure. Measurement of the γ-ray activity of rock samples is one application of the chamber. L. E. M.

537.5

6275. The counting volume of a cylindrical ionizati chamber. BLACHMAN, N. M. *Rev. Sci. Instrum.*, 2 477–9 (*July*, 1949).—The effect on the electric fie inside a circular-cylindrical ionization chamber of t end plates is determined. The field lines terminati on the collecting wire at the ends of the guard sleev determine the volume in which the freed electrons a collected by the wire. Formulae and a graph f determining this counting volume are exhibited. appendices effects of the sleeves are considered, a the inverse-square integral evaluated for bo cylindrical and spherical ionization chambers.

537.5

6276. Coincidences of collisions in several ionizati chambers. NIKOLAEV, V., NIKOLSKI, S. AND RAZOR NOV, L. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 4) 481 (1949) *In Russian.*—Cylindrical chambers of 11 c dia. and effective electrode length of 25 cm, A-fille were used, the impulses being amplified by a 4-chan linear amplifier, and recorded photographically loop oscillograph. The simultaneous recording collisions from 4 chambers on the same film enabl double, triple and quadruple coincidences to separated. The resolving time was 0·1 sec. Tv tests were made, in the first of which the 4 chambe were closely grouped and unscreened, whilst in t second an Al filter of 1·2 cm thickness surround the chambers. The min. ionization in a chamb corresponded to 0·25 of that of an α-particle of P The number of fortuitous coincidences was determin experimentally, by spacing the chambers to 1 distance. It was established that individual proto cannot produce strong collisions coinciding in tv chambers. The double coincidences can only explained by heavily ionizing particles from nucle disintegrations, occurring in the walls of the chambe The number of double coincidences is hardly affect by absorbing substances placed between the chambe This contradicts the assumption that coincidenc may be produced by nuclear fission occurring in t wall of one chamber, debris of which penetrate in another chamber. The double coincidences mu thus be due to simultaneous star formation in tv chambers, even though the mechanism of th phenomenon cannot be explained yet. The mu lower number of quadruple coincidences correspon to the data of counter measurements on the wi showers, more particularly where the number of su showers of a density higher than a certain given o is concerned. The marked difference in the intens of ionization in several chambers due to one wi shower, previously established with a pair of chambe was again observed. In quadruple coincidences t average relative deviation from the average ionizati was $> 0·2$. The use of a greater wall thickness the chambers leads to an improvement in t correlation of the pulse intensities in the chamber B. F.

537.542 : 615.8

A negative feedback dosage rate meter with sm ionization chamber. *See Abstr.* 6642

537.5

6277. Distant counting of scintillations. BLIZAR E. P. AND DEBENEDETTI, S. Note in *Rev. S*

nstrum., **20**, 81 (*Jan.*, 1949).—To remove the photo-multiplier of a scintillation counter from the disturbing influence of magnetic fields and direct radiation the cintillation crystal was separated from the photo-multiplier and the light canalized by an internally eflecting tube 1 m long. Good results were obtained. H. MO.

537.542

6278. Decay of scintillations in calcium fluoride rystals. MACINTYRE, W. J. Letter in *Phys. Rev.*, **75**, 1439–40 (*May* 1, 1949).—The coincidence rate etween pulses in a prop. counter and a CaF_2 cintillation counter, caused by the same (P^{32}) β-particles, was measured as a function of a variable elay in one channel. The exponential decay curve ad a ½-life of 15×10^{-8} sec, const. over the temp. ange −80° — +20°C. A. O. S.

537.542

6279. Scintillation counters using organic compounds. HARDING, G. N., FLOWERS, B. H. AND EPPSTEIN, J. S. Letter in *Nature, Lond.*, **163**, 990 (*June* 25, 1949).—The efficiencies of crystals of nthracene, stilbene and naphthalene for α-particles f various energies were compared with that of KI + Tl using a photo-multiplier and single-channel ulse analyser; for ThC′ α-particles (8·78 MeV) the ulse-heights were in the approx. ratios 4 : 2 : 1 : 8 esp. For KI + Tl, but not for the organic phosphors, he pulse-height ∝ α-particle energy. Purification ffected the pulse-distributions due to Co γ-rays on he powdered phosphors; the purest available materials were used. A. O. S.

537.542 : 535.376

Fluorescence of bombarded anthracene. *See Abstr.* 5122

537.542

6280. A large cloud chamber using rear illumination. COWAN, E. W. *Rev. Sci. Instrum.*, **20**, 492–5 (*July*, 1949).—A large cloud chamber is described that makes use of rear illumination by means of a transparent piston and back plate. This system of illumination is particularly advantageous for a large cloud chamber since the increase in the amount of scattered light for small angles of scattering from droplets reduces the total light required. A.

537.542

6281. Pulse height distribution analyzer. GLENN, W. E., JR. *Nucleonics*, **4**, 50–61 (*June*, 1949).—The analyser is based on a special cathode-ray tube having a set of 50 electrodes at its wide end. The α-particle pulse from an ionization chamber with electron collection is amplified and made rectangular. It is then used to trigger the beam in the c.r. tube, at a deflection ∝ the original pulse size. A current of ~0·3 μA lasting ~5 μsec impinges on the corresponding electrode, and after amplification in a 3-tube circuit is used to drive a mechanical counter. The c.r. tube is of metal and continuously pumped (a sealed-off version in glass was made subsequently). Full circuit details are given, but no specimen analyses are shown. The use in a similar way of an ordinary c.r. tube in conjunction with 2 photo-multipliers for short ½-life determinations, by measuring time-delays between α-particles from successive disintegrations, is also described. A. P. F.

537.542 : 621.317.75

6282. A direct reading pulse length meter and shape analyzer. RUDIN, R. *Rev. Sci. Instrum.*, **20**, 467–71 (*July*, 1949).—An electronic circuit is described which allows determination of the length and shape of a voltage or current pulse in the μsec range, by measuring the pulse duration at different levels of the pulse and reading these figures directly on a meter. Comparison with other measuring methods shows good agreement of the results. A.

537.542 : 621.318.572

6283. Stable ten-light decade scaler. WEISSMAN, R. *Electronics*, **22**, 84–5 (*May*, 1949).—The equipment employs 6 stages, of which the first 5 are double-triode stages of Eccles–Jordan pairs, forming a ring-of-five circuit. This is coupled through a double-diode to the anodes of one scale-of-two stage. Normally all left-hand (l.h.) halves are conducting and all right-hand (r.h.) halves cut off, the abnormal condition existing as a stable state in one element only at a time, but advancing one stage down the chain for each count. All l.h. cathodes are connected through one common by-passed resistor to earth, and similarly with the r.h. cathodes. As a result, the input wave-shape and amplitude are non-critical, while the capacitor and resistor tolerances are generally broad. Of the 10 Ne-tubes (2 per stage of the ring-of-five circuit) none associated with a normal stage can light, while for the abnormal stage, one lights for counts 0 to 4 and the other for 5 to 9. The output is sufficient for driving a further decade. H. G. M. S. (R)

537.542 : 621.318.572

6284. Electronic pulse counters. I. Electronic scaling circuits. NASLIN, P. *Onde Élect.*, **29**, 241–54 (*June*, 1949) *In French.*—A review of existing scaling circuits and their applications. A. O. S. (R)

537.542

6285. A circuit for the study of the operation of the Geiger–Müller counter. GUIMARÃES, M. A. AND SAMPAIO, P. A. *Rev. Sci. Instrum.*, **20**, 485–8 (*July*, 1949).—The vacuum tube circuit described in this paper was designed in order to measure the effective dead-time (σ') of a Geiger–Müller counter and the probability (α') of occurrence of spurious discharges within a given interval of time ($\zeta - \sigma'$) after an initial discharge. The experimental results obtained permit, by means of an adequate formula, the determination of (α') and, in some cases, (σ'). A.

IONIZATION . THERMIONICS 537.56/.58

537.56

6286. Observations on the ionization produced by high voltage radiation in moulded ionization chambers with walls of various effective atomic numbers. ALY, S. M. AND WILSON, C. W. *Brit. J. Radiol.*, **22**, 243–54 (*May*, 1949).—Experimental and theoretical observations on the ratio of ionization in pairs of condenser chambers, one "air-walled" and the other having an

effective atomic number, 12·84, 17·04 or 20·84. Ionization ratios were measured by the Kemp dosemeter [see Abstr. 2398 B (1946)]. Over a range of wavelengths from γ-rays (0·013 Å) to 0·5 Å measured and calculated ratios agree up to 0·08 Å, but there is a divergence at longer wavelengths. A semi-empirical modification of the Bragg–Gray theory is proposed in order to explain these results. For photo-electron energies > 170 keV the contribution to the ionization by the photo-electrons appears to be complete; below this energy the contribution diminishes regularly with photo-electron energy. T. A. C.

537.56

6287. The lateral distribution of ions across the track of an ionising particle. I. READ, J. *Brit. J. Radiol.*, **22**, 366–74 (*July*, 1949).—Expressions are deduced for the radial electric field across the track of an ionizing particle, the corresponding potential differences, and the energy per ion pair stored in the field. Numerical values are obtained for an ion density of 1 000 ions per micron in water, hexane and a chromosome thread. The field is of the order of 10^5 V/cm at relatively large distances from the axis of the track. T. A. C.

537.563

6288. Effect of temperature on mass spectra. STEVENSON, D. P. Letter in *J. Chem. Phys.*, **17**, 101–2 (*Jan.*, 1949).—An explanation of the effects observed by Fox and Hipple in their work on isobutane [Abstr. 1891 (1947)]. S. T. H.

537.565

6289. A mobility analyser for gaseous ions. II. The effect of the grid thickness. LANGEVIN, P. *J. Phys. Radium*, **10**, 225–34 (*July–Aug.–Sept.*, 1949) *In French.*—A discussion of the detailed theory of the mobility apparatus described in Part I [see Abstr. 5504 (1949)] is given. The grid under discussion is that which, when rotating, moves a layer of gas in the space between two concentric cylinders, and through which the ions pass on their transit from the inside to the outside cylinder. The present paper deals with two aspects of the moving (grid) cylinder, viz. (*a*) the effect of the grid spacing, thickness, etc., on the movement of the gas; and (*b*) the effect of the same parameters on the electric field distribution in the apparatus. The treatment is developed mathematically. Finally, a short section is given on the paths followed by the ions. No experiments are described. J. D. C.

537.568

6290. The clustering of ions and the mobilities in gaseous mixtures. OVERHAUSER, A. W. *Phys. Rev.*, **76**, 250–4 (*July* 15, 1949).—It is shown by direct analysis that the deviations from Blanc's law for mobilities of ions in mixtures of gases observed when a strongly polarizable gas is mixed with one less polarizable cannot be ascribed to a statistical clustering effect as proposed by Loeb. Analysis involving the assumption that the ion undergoes labile clustering of the simplest type indicates that the observed results can be completely accounted for within the realms of simple theory. Thus assuming that the active gas can attach a single molecule to the ion and that this attachment molecule may be detached with different probabilities by collisions with the two types of gas molecules leads to an equation for the resultant mobilities which will cover practically all cases observed. The forces assumed can be dielectric but may also be secondary valence or van der Waals forces. It is indicated how, with appropriate experimental procedures possible under modern techniques, most of the constants required for the solution of the equation can be directly determined or computed. A.

537.58 : 541.18.

6291. Lifetime of adsorbed alkali on heated tungsten. KNAUER, F. *Z. Phys.*, **125** (*Nos* 4–6) 278–89 (1948) *In German.*—The lifetime was measured by interrupting a molecular beam by a rotating slit and studying the ion current from the heated W target as a function of time. The results were:

$$\text{Cs: } \log_{10}\tau = -16{\cdot}35 + 1\,820/T \quad (\text{for } 1\,290 < T < 1\,520°\text{K})$$

$$\text{K: } \log_{10}\tau = -11{\cdot}70 + 14\,700/T$$

The adsorption energies calculated from the Clausius–Clapeyron equation were Cs = 3·6 eV; K = 2·9 eV. Departures from linearity were observed when the coverage was > 0·003. A. H. W. B.

537.581 : 621.385.1.032.21

6292. On the periodic temporal variations of anode current in an oxide-cathode vacuum tube. CHAMPEIX, R. *C.R. Acad. Sci., Paris*, **223**, 786–8 (*Nov.* 13, 1946) *In French.*—With tubes working in space-charge limited conditions, anode currents were found to vary over a range of nearly 2 : 1 with a fairly regular periodic time, varying from tube to tube between 15 min and 4 hr. The cathode temp. greatly affects the periodicity and the effect is more marked at lower temps. It is suggested that the phenomenon is due to the formation of localized patches, of high work function, on the cathode surface. J. D. C.

537.582

6293. Thermionic constants of platinum. KONDO, K. *J. Phys. Soc. Japan*, **2**, 6–8 (*Jan.–April*, 1947) *In English.*—Values of the emission constants, A and ϕ, more nearly in agreement with the theoretical values are obtained by prolonged degassing at high temps (1 700 to 1 925°K). The values obtained at various stages in the degassing procedure are quoted and reasons for their variations are suggested. The correct assessment of the true area of the emissive surface is discussed. T. E.

537.582

6294. Thermionic constants of platinum. II. On face excess developed by etching. KONDO, K. *J. Phys. Soc. Japan*, **2**, 36–40 (*May–June*, 1947) *In English.*—Develops approximate formulae for face excess by considering rate of crystal growth at surface. The results (for body centred cube lattice) are compared with Tonks' theory and experimental data. T. E.

537.582

6295. On the relation between thermionic constant and work function. KONDO, K. *J. Phys. Soc. Japan*, **2**, 32–5 (*May–June*, 1947) *In English.*—Empirically $\log A \propto \phi + \text{const.}$ To confirm this experimentally the emission is measured as outgassing proceeds, with a stable monolayer. Results are given of measure-

nents on pure Pt with O monolayer. From the heory developed values of potential barrier are leduced and compared with other available data. T. E.

537.582

6296. On the apparent temperature coefficient of work function. ARIZUMI, T. *J. Phys. Soc. Japan*, **3**, 43–50 (*March–June*, 1948) *In English.*—The experimental determination of thermionic constants only gives consistent results using different methods if he work functions are uniform over the surfaces, nd different work functions have different temp. oeffs. 4 methods of measurement are discussed, nd the $\partial\phi/\partial T$ values of oxide coatings and pure W quoted. T. E.

537.583

6297. On the bombardment of thorium tungsten by he alkali metal ions. KAWAMURA, H. AND SHIMAZU, J. *J. Phys. Soc. Japan*, **3**, 126–9 (*March–June*, 1948) *In English.*—Decrease of activity of thoriated W when ombarded by positive ions is due to sputtering of Th atoms, but the effect is decreased by carbonization of the W surface: this effect was investigated experimentally using alkali metal ions, and the cause was ound to be due rather to the form of the adsorption otential curve of the carbonized surface than to the ctual value of the adsorption energy itself. F. LL. J.

537.583 : 621.385.1.032.216

6298. Thermionic emission from sintered cathode of horia and tungsten mixture. FAN, H. Y. *J. Appl. Phys.*, **20**, 682–90 (*July*, 1949).—To obtain suitable onductivity for direct heating, W powder is added o sintered thoria cathodes. The thermionic properties of a cathode, sintered from a mixture of 67% thoria nd 33% W, were investigated. Emission constants were determined and the emission was found to be omewhat lower than that of cathodes sintered from ure thoria. Change of cathode activity with temp. as observed and studied in detail. The cathode howed high activity at temps. which would bring bout deactivation of ordinary thoriated W and ecreased its activity when the temp. was lowered to he range where thoriated W would be activated. A theory is proposed for the mechanism of the change n activity, involving the production of free Th due o reduction of thoria by W, diffusion and evaporation f Th from thoria. Evaporation of Th as well as horia was proved by the use of a W filament probe hich detected evaporation of materials from the athode by the change of its own emission. The nergy of evaporation of free Th from thoria is stimated from the experiments to be 46 600 cal./g-tom. The energy of evaporation of thoria is found o be 184 000 cal./g-molecule. The behaviour of the athode is satisfactorily explained by the proposed heory. A.

537.585

6299. Emission of positive ions by incandescent oxides of titanium, zirconium and silicon. STARODUBTSEV, S. V. AND TIMOKHINA, YU. I. *J. Tech. Phys. USSR*, **9**, 606–10 (*May*, 1949) *In Russian.*—SiO_2, TiO_2, ZrO_2 and PbO were heated by means of a W spiral n a vacuum of $\sim 10^{-6}$ mm Hg, the pencil of ions ormed being analysed by means of a mass spectrometer with a resolving power $\simeq 3\%$ of the mass. In all cases emission of K^+ and Na^+ was observed. The optimum condition for the emission of Ti^+ was at 1 000°K; Ti, TiO and TiO_2 were also observed. The optimum temp. for Zr^+ was approx. 2 200°K, the current due to Zr^+ being 4×10^{-6} A at this temp.; ZrO_2 and ZrO^+ were observed. Emission of Si^+ started at 1 900°K, SiO_2^+ and SiO^+ being observed, over a period of 3–5 min it was possible to maintain a current of Si^+ of 3×10^{-6} A. In the case of PbO, evaporation of Pb occurred, no Pb or PbO being found. Control experiments carried out in order to exclude bulk ionization demonstrated the absence of any change in the character of the emission, in the relative values of both the atomic and molecular ion currents for TiO_2 and ZrO_2. In the case of SiO_2 a sharp difference was observed, no SiO^+ and SiO_2^+ being observed: the max. corresponding to Si^+ was scarcely observable. W. H.

COSMIC RAYS 537.591

537.591

6300. Cosmic rays. I–II. JAUCH, J. M. *Nucleonics*, **4**, 39–51 (*April*); 44–58 (*May*, 1949).—A rather general survey of the principal cosmic-ray phenomena. Elementary theoretical treatments are given of the Störmer cone and of shower production. The latter is discussed under the assumption that bremsstrahlung and pair creation are the only processes involved. The present state of knowledge concerning light and heavy mesons is reviewed. The evidence leading to the conclusion that the primary particles are nearly all protons is given at some length. Finally some speculations on the origin of the primary particles are summarized. Reasons are given for preferring an acceleration hypothesis to an annihilation mechanism, but the tentative nature of any theory is emphasized. There are 72 refs., taken from the earliest and the latest work in various fields. A. P. F.

537.591

6301. Energies of heavy nuclei in cosmic rays. FREIER, P., NEY, E. P. AND OPPENHEIMER, F. Letter in *Phys. Rev.*, **75**, 991–2 (*March* 15, 1949).—Fifteen heavy primary nuclei ($9 < Z < 42$) detected in photographic emulsions at from 70 000 to 90 000 ft altitude at 55° N geomagnetic latitude are shown to have had energies per nucleon $0{\cdot}45\times10^9\ \text{V} < E < 1{\cdot}3\times10^9\ \text{V}$ at entry to the atmosphere. Results suggest that the magnetic field of the sun is not excluding any of these particles at this latitude which are not also excluded by the magnetic field of the earth. J. G. W.

537.591.1

6302. Evidence for the stellar origin of cosmic rays. RYLE, M. *Proc. Phys. Soc. Lond. B*, **62**, 491–9 (*Aug.*, 1949).—Several authors have suggested the possibility that cosmic rays are due to the acceleration of charged particles in the atmospheres of certain stars. Recent observations at radio frequencies have provided some evidence in support of this hypothesis which is reviewed in this paper. The observations have shown that at least part of the radio-frequency radiation from

the galaxy is emitted by discrete sources of small angular diameter. Measurements of the intensity of the radiation from these sources, and of the time variations of the intensity, indicate that the sources emit radio waves as if they were at a temp. of $> 10^{14}$ °K. It is concluded that this intense radiation cannot be caused by the coherent oscillation of a large number of electrons, but must be due to a genuine electron temp. of about 10^{14} °K (corresponding to a mean electron energy of 10^{10} eV). The existence of this electron temp. indicates that in certain stellar bodies there are mechanisms capable of accelerating particles to cosmic-ray energies. A previous theory of the emission of radio waves from the sun is extended to other stellar bodies. It is concluded that a star having a surface magnetic field strength and a peripheral velocity somewhat > those which have so far been observed could emit radio waves having the observed intensity. A star of this type could also accelerate charged particles to cosmic-ray energies. The small visual brightness of the sources of radio waves suggests that these bodies may be characterized by small visual opacity or small photospheric temp. It is suggested that the difference between the angular distribution of cosmic rays and of the radio waves from the galaxy is due to the deflection of cosmic-ray particles by magnetic fields. In addition to previous theories of a general magnetic field in the galaxy, it is shown that the scattering produced by the magnetic fields of the distributed sources themselves should be sufficient to produce an isotropic distribution of cosmic rays at the earth even though the sources may show a marked concentration near the galactic equator. A.

537.591.1

6303. On the cosmic ray component producing nuclear events in photographic emulsions. CÜER, P. AND MORAND, M. "*Cosmic Radiation*," *London, Butterworth's Scientific Publications Ltd.*; *New York, Interscience Publications Inc.* (1949) 39–42.—Nuclear cosmic events, easily identifiable principally with B and C, were systematically compared with reactions produced by experimental high energy neutrons, 20 to 95 MeV. The dynamics of cosmic stars are compatible in general with a neutronic source. The coeffs. of absorption of the component products of stars and tracks are similar to that of events considered to be produced by nucleons. It has been possible to calculate quantitatively the important value of the coeff. in Pb by "geometrical" considerations. Some experimental evidence is put forward for minimum intervention of the γ-component in stars. The light effect of transition under small thicknesses of Pb can be entirely accounted for by changes in the neutronic energy spectrum and its spatial distribution. A.

537.591.15

6304. Interpretation of bursts in thin-walled chambers. FUJIMOTO, Y. AND YAMAGUCHI, Y. Letter in *Progr. Theor. Phys.*, **4**, 101–2 (*Jan.–March*, 1949) *In English.*

537.591.15

6305. Generation of showers by the meson component of cosmic radiation. TRUMPY, B. *Bergens Museums Årb.* (*No.* 8) 20 pp. (1939–40) *In German.*—Using a system of Geiger counters, measurements were performed on the properties of showers secondary to the meson component. The second max. is found to disappear for narrow-angled showers, contrary to the results of Bothe [*Naturwiss.*, **27**, 305 (1939)]. Results on the absorption of the shower particles are reported which show that narrow-angled showers are more penetrating than wider-angled showers. The number of secondaries caused by mesons in Al was investigated using a cloud chamber, and the results are stated to confirm the theory of Bhabha.

E. P. C

537.591.1

6306. On the theory of air-showers. I. The mean squares of displacement and of angular scattering. MOLIÈRE, G. *Z. Phys.*, **125** (*Nos* 4–6) 250–68 (1948). *In German.*—The spread of a cascade shower in air is described by the quantities (θ^2), $(\bar{\theta} \cdot \bar{r})$ and $(\bar{r}^2)$, where the lateral displacement, r, from the shower axis of a particle trajectory is measured in a plane perpendicular to the shower axis, and the angle, θ, is measured between the trajectory and the normal to the plane at the point of intersection, for electrons and photons. The importance of the contribution of the "last generation" is indicated.

J. G. W

537.591.1

6307. On the showers of mesons and nucleons. WATAGHIN, G. Letter in *Phys. Rev.*, **75**, 693 (*Feb.* 15, 1949).—A fast nucleon-nucleus collision is considered in a model leading to a fractional loss of energy by the primary nucleon, the energy lost being shared among nucleons and created mesons. It is shown that $\sim 70\%$ of energy is expected to remain with a fast nucleon, and that the exponent of the density spectrum of meson showers should be identical with that of the energy spectrum of primary protons.

J. G. W

537.591.1

6308. The vertical intensity at 10 000 ft of ionising particles that produce penetrating showers. HAZEN, W. E., RANDALL, C. A. AND TIFFANY, O. L. Letter in *Phys. Rev.*, **75**, 694–5 (*Feb.* 15, 1949).—A cloud chamber study (5×1 in Pb plates, ionizing primaries selected) at 10 000 ft indicated an intensity of ionizing penetrating, shower-producing radiation $(1{\cdot}1 \pm 0{\cdot}3)\ 10^{-5}$ cm^{-2} sec^{-1} sterad.$^{-1}$ at this altitude.

J. G. W

537.591.1

6309. Cascade theory. SNYDER, H. S. Letter in *Phys. Rev.*, **75**, 906–7 (*March* 1, 1949).—Criticisms by Bhabha and Chakravarty [Abstr. 1087 (1949)] of a solution of the cascade equations given by Serber and by Snyder are discussed. G. J. I

537.591.1

6310. Coincident bursts in small ionisation chambers. MONTGOMERY, C. G. AND MONTGOMERY, D. D. Letter in *Phys. Rev.*, **75**, 980 (*March* 15, 1949).—Coincidences were studied between an extended counter array (area ~ 350 cm^2) and two separate ionization chambers, 3 in dia., $\frac{1}{32}$ in steel wall 9 cm separation, 200 lb/in^2 A recording by galvanometer of period 1·5 sec. It was established that radioactive wall contamination was suppressed as a pulse

ource at the pressures used. Bursts of upwards of ·5 MeV detected in chambers. No coincidences ither between the chambers, or including also the ounter array, above the background of fortuitous ounts was obtained at sea level or at 3 500 m. Concluded: that bursts must be due to heavily ionizing articles of long enough range to bring them to the igh field region in the chambers. J. G. W.

537.591.15

6311. Local production of the penetrating particles n extensive showers. SALVINI, G. AND TAGLIAFERRI, . Letter in *Phys. Rev.*, **75**, 1112 (*April* 1, 1949).— n view of contrary suggestions, the authors reaffirm heir belief that the penetrating particles in extensive howers are produced in the local absorbers. The pparent conflict between the results of different workers is resolved in terms of counter geometry. E. P. G.

537.591.5

6312. Note on the east-west effect. BIEHL, A. T., NEHER, H. V. AND ROESCH, W. C. Letter in *Phys. Rev.*, **75**, 688–9 (*Feb.* 15, 1949).—Measurements at the geomagnetic equator (Peru) at 30 000 ft (3·1 m water equivalent) and 38 000 ft (2·35 m water) were made of the E–W intensity variation of cosmic rays with 0, 10 and 20 cm Pb in the detecting telescopes. It was found that at these altitudes the total W excess is almost as large as that of the penetrating component alone, while the asymmetry increases between 30 000 ft and 38 000 ft. The differences may be due to increased scattering of the lower energy particles with increasing depth in the atmosphere, and it is concluded that one kind only of positive primaries is needed to account for the E–W behaviour of both hard and soft components. J. G. W.

537.591.5 : 523.75

6313. On the mechanism of sudden increases of cosmic radiation associated with solar flares. FORBUSH, S. E., GILL, P. S. AND VALLARTA, M. S. *Rev. Mod. Phys.*, **21**, 44–8 (*Jan.*, 1949).—The possibility of charged particles being accelerated in the varying field of a sunspot to energies of the order 10^{10} eV is considered, and it is further suggested that the interaction of the steady magnetic field of the sun and the varying field of the sunspot may lead, for a short time, to the existence of a "tunnel" through the region near the sun which is forbidden to these particles in the Störmer theory of the steady solar field. The transit time of these particles to the earth is then considered reasonable. J. G. W.

537.591.8

6314. Creation of a "σ"-meson by a highly ionising nucleus in the cosmic radiations. LORD, J. J. AND SCHEIN, M. *Science*, **109**, 114 (*Feb.* 4, 1949).—The observation in a photographic plate flown by free balloons, of the creation of a σ-meson by a heavy nuclear fragment, is reported. It is estimated that the fragment possessed between 7 and 20 electronic charges and had a max. energy of several BeV at the point where the meson was created. U. C.

537.591.8

6315. Emissions of mesons in cosmic stars in photographic emulsions. PICKUP, E. AND MORRISON, A. Letter in *Phys. Rev.*, **75**, 686–7 (*Feb.* 15, 1949).— Events in Ilford C2 plates, loaded B, Li or D, exposed in aircraft at 12 000 to 15 000 ft are discussed. The number of $(\pi + \sigma)$ mesons, in agreement with balloon experiments, but lower than that observed on mountains, appears to be sensitive to the amount of material near the point of observation. J. G. W.

537.591.8

6316. Double stars with relativistic particles from cosmic rays. COSYNS, M., DILWORTH, C. C., OCCHIALINI, G. P. S. AND SCHÖNBERG, M. *Nature, Lond.*, **164**, 129–31 (*July* 23, 1949).—Events in photographic emulsions sensitive to particles at min. ionization in which there are two centres of action are discussed. In particular, the β-decay of star products is identified, while other events may arise from meson emission in the charge transition of a nucleon. J. G. W.

537.591.8

6317. Nuclear transmutations produced by cosmic-ray particles of great energy. I. Observations with photographic plates exposed at an altitude of 11,000 feet. BROWN, R. H., CAMERINI, U., FOWLER, P. H., HEITLER, H., KING, D. T. AND POWELL, C. F. *Phil. Mag.*, **40**, 862–81 (*Aug.*, 1949).—Kodak NT4 plates, with "electron-sensitive" emulsions, 200 μ or 400 μ thick were used. It is shown that about half the nuclear disintegrations in which many charged particles are emitted are produced by particles of charge $|e|$, moving at relativistic velocities; the other half is attributed to a neutral radiation. Most "primary" particles move within a cone of semi-angle 40°; they appear to pass through nuclei, imparting energy to the nucleons so that the nuclei evaporate, and have a 50% chance of suffering a change of charge $|e|$ in each encounter. If the energy is sufficiently great, "showers" of charged particles are produced. Photo-micrographs of several examples of "stars" are given. L. S. G.

MAGNETISM 538

538.082.1

6318. Sensitive magnetometer for measurements of coercive force of electrodeposited iron layers. TOBALINA, A. *An. Real. Soc. Esp. Fis. y Quim.*, **44**, 5–26 (*Jan.–Feb.*, 1949) *In Spanish.*—Cu rods, 8×0·2 cm, plated from $FeCl_2$, $CaCl_2$, hydroquinone solution ($pH \sim 3$) are magnetized in a water-cooled solenoid which will give H of 500 oersteds. Magnetization is measured by suspended astatic system of 38 magnets, each 11×0·6 mm, protected from stray fields by compensating coils. Coercive force of the plated layer varies exponentially with thickness, falling from 80 to 20 oersteds as thickness rises from 0·07 to ~ 2 μ, remaining roughly constant thereafter. N. F. A.

538.082.1

6319. Magnetic susceptibility balance for use at liquid helium temperatures. MCGUIRE, T. R. AND LANE, C. T. *Rev. Sci. Instrum.*, **20**, 489–91 (*July*, 1949).—Data are presented on the design and performance of an apparatus for the measurement of magnetic susceptibilities at the temps. attainable with

liquid helium. After extensive trials, the instrument has proved itself easy and reliable in operation and especially suited to measurements on small specimens. A.

538.114

6320. Advances in the theory of ferromagnetism. BOZORTH, R. M. *Elect. Engng. N.Y.*, **68**, 471–6 (*June*, 1949).—A short account of recent developments. Domain theory and domain shapes as deduced from powder photographs, the high coercive force associated with fine particles, and ferromagnetic resonance are discussed. A. E. DE B.

538.22

6321. Ferromagnetic alloys in the system copper-manganese-indium. GRINSTEAD, R. R. AND YOST, D. M. Letter in *Phys. Rev.*, **75**, 984–5 (*March* 15, 1949).—A preliminary report of the preparation and thermal analysis of about 15 alloys with Cu–Mn atomic ratio of 2 : 1 and up to 60 atomic % In. All except binary Cu–Mn alloys are ferromagnetic, and the probability of more than one magnetic phase occurring is suggested. C. E. W.

538.221

6322. On the structure of "90°-magnetic wall" in the ferromagnetic crystal. TSUYA, N. *J. Phys. Soc. Japan*, **3**, 176–7 (*March–June*, 1948) *In English.*—A short quantum mechanical treatment of a 90° wall shows that it is of the same nature as the 180° wall and that the breadth of the wall is 100—1 000 × the lattice parameter. A. E. DE B.

538.221

6323. On the theory of antiferromagnetism. TSUYA, N. *J. Phys. Soc. Japan*, **3**, 161–7 (*March–June*, 1948) *In English.*—The problem is discussed on the basis of Miyahara's band theory assuming that the many types of antiferromagnetism are caused by the various types of state density distribution of occupied electronic energy bands. The observed magnetic and thermal characteristics of manganous selenide are in agreement with the calculated properties. A. E. DE B.

538.221

6324. Anomalous magnetic behaviour of nickel-iron at high frequencies. WIEBERDINK, A.; KRONIG, R. Letter in *Nature, Lond.*, **162**, 527–8 (*Oct.* 2, 1948).—Measurements are made of the wavelength of standing-waves on two concentric lines, whose inner conductors are of Cu and Ni–Fe respectively. An anomalous dispersion is found over the wavelength region between 70 and 100 cm, a permeability of < 1 being indicated at $\lambda = 87$ cm. A theoretical explanation on the domain theory is outlined. G. F. H.

538.221

6325. Ferromagnetic resonance in crystal fields. KRONIG, R. *Physica*, **15**, 264–5 (*April*, 1949) *In English.*—It is suggested that the resonance frequency found by Wieberdink (preceding Abstr.) represents the frequency of precession of the magnetization of a Weiss domain in the crystal field which tends to give this magnetization a preferential orientation with respect to the crystal axes. G. F. H.

538.221 : 621.3.013 : 621.318.22.042.1

6326. On the variation of a.c. permeability of transformer sheet steels with d.c. magnetization. BANERJEE, B. M. *Indian J. Phys.*, **22**, 265–75 (*June*, 1948).—Gives curves showing the variation of a.c. permeability with superposed d.c. magnetization for samples, chiefly of stalloy stampings, at constant a.c. flux densities. The inverse of the a.c. permeability varies approximately linearly with d.c. magnetizing force. Oscillograms of a.c. hysteresis loops show that they are symmetrical even with superposed d.c. magnetization, and that appreciable odd harmonics are present in the magnetizing current even at small a.c. flux densities. The effect of air-gaps on the variation of inductance with d.c. magnetization is also shown. C. E. W. (R.

538.221 : 621.318.22

6327. A recent development in soft magnetic materials. SCHOLEFIELD, H. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 207–9 (*June*, 1949).—Describes the development, manufacture, structure and properties of a new magnetic material "H.C.R.," characterized by a rectangular hysteresis loop, particularly suitable for use in the circuits of magnetic amplifiers, heavy-current mechanical rectifiers and similar devices. The correlation of the magnetic properties with preferred orientation is discussed and a brief description of its use in two applications is given. A.

538.221 : 621.318.22.042.15

6328. Magnetic properties of iron compacts in relation to sintering temperature. STEINITZ, R. *J. Appl. Phys.*, **20**, 712–14 (*July*, 1949).—Previous experiments have indicated that the magnetic permeability of sintered iron compacts is largely determined by the final density of the compact. The permeability of 5 different Fe powders proved to be independent of the origin of the powder, if the compacts were sintered at the same temp. The results were compared with the theory of Polder and Van Santen and agreed very well with their predicted curve, if the residual pores were assumed to be flat discs. It could be expected that at higher sintering temps., the disc-shaped pores would change into a more equiaxial or spherical shape. A.

538.222

6329. Magnetic studies on single crystals of tungstenite (WS_2). DUTTA, A. K. AND CHOWDHURY, B. C. R. *Indian J. Phys.*, **23**, 131–43 (*March*, 1949).—Magnetic measurements on single crystals of tungstenite have been undertaken, and unlike molybdenite, it was found to be paramagnetic. The paramagnetic susceptibility along the hexagonal axis, $\chi_{\parallel}$, is about $4\,917 \times 10^{-6}$ c.g.s. e.m. units per g mol. at 30°C while $\chi_{\perp}$, that at right angles to the axis is about $6\,314 \times 10^{-6}$ c.g.s. e.m. units per g mol. at the same temp., which corresponds to an anisotropy of about 24%. These measurements have been extended to various temps. ranging from 700°K down to about 80°K. The effective magnetic moment along both the directions have been found to have maxima values near the room temp. and have been found to decrease continuously with either increase or decrease of temp. within the present range. W^{+4} ion is in a ground state $5d^2\,{}^3F_2$ and the

vailable X-ray data indicate that the crystalline lectric field acting on the ion is presumably of a igonal symmetry. The Stark pattern of the ground ate under such a field is shown to be one degenerate oublet lying lowest and one singlet separated from by several hundred cm^{-1}. On this basis an xplanation of the anisotropy and the variation of agnetic moments with temp. has been attempted. A.

538.222

330. Complex ions. IX. Magnetic susceptibilities f nickel and cobalt complex ions from 0 to 80°. IELD, F. H. AND VOSBURGH, W. C. *J. Amer. Chem. oc.*, **71**, 2398–401 (*July*, 1949).

538.222

331. Microwave absorption spectra of para-agnetic salts. TING, Y., WEIDLER, R. C. AND VILLIAMS, D. Letter in *Phys. Rev.*, **75**, 980 (*April* 15, 949).—Observations on Cr, Mn and Fe salts. D. H. W.

538.222 : 539.152.1

332. Hyperfine structure of the paramagnetic esonance spectrum of divalent cobalt. BLEANEY, B., NGRAM, D. J. E. AND PRYCE, M. H. L. Letter in *lature, Lond.*, **164**, 116–18 (*July* 16, 1949).—Using pecimens of Zn ammonium sulphate containing $< 0{\cdot}1\%$ of the corresponding Co salt the hyperfine tructure in the paramagnetic resonance spectrum of Co^{++} has been examined and reveals two types of aramagnetic ions each subject to identical crystalline lectric fields but differing in the orientation of axes. he derived nuclear spin of Co is 7/2. Preliminary ork on very dilute crystals of manganese ammonium ulphate and manganese fluosilicate and on neo-ymium ethyl sulphate is mentioned. A preliminary iscussion of the theoretical implications of the results ollows. W. R. A.

538.224

333. Diamagnetic susceptibility and anistropy of ce. LONSDALE, K. Letter in *Nature, Lond.*, **164**, 101 *July* 16, 1949).—Diamagnetic anistropy of ice is so mall that it is difficult to measure; thus it must be property of the water molecules themselves and ot a directive property of hydrogen bonds. The ethod of measurement is described. W. R. A.

538.24

334. Statistical study of the Barkhausen effect. AWADA, H. *J. Phys. Soc. Japan*, **1**, 3–5 (*July–Dec.*, 946) *In German.*—The results obtained by measuring he number and distribution (magnitude and time) of Barkhausen jumps for an Fe wire containing 3% Si ere treated statistically and found to be in good greement with a simple theory. H. J. H. S.

538.244.2 : 621.318.3

335. The design of an electromagnet with rect-ngular pole pieces. KISTEMAKER, J. *Appl. Sci. Res.*, **B 1** (*No.* 4) 268–72 (1949) *In English.*—An nvestigation has been carried out on the homo-eneity of the magnetic field of an electromagnet ith rectangular pole pieces, as a function of the size f the gap. A.

538.244.2 : 621.318.3

336. New coil systems for the production of uniform agnetic fields. BARKER, J. R. *J. Sci. Instrum. hys. Ind.*, **26**; 273–5 (*Aug.*, 1949).—Systems of 3 or 4 identical, air-cored, circular coils for producing an extended uniform magnetic field are described. Assuming that the coil cross-sections are very small, the separations of these coaxial coils and the currents in them are first given and the finite cross-section of real coils are then considered. Practical methods of setting up the coil systems are discussed. A.

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3

6337. Instrinsic structure of the electromagnetic field. GIORGI, G. *Acta Pont. Acad. Sci.*, **9** (*No.* 10) 95–102 (1945) *In Italian.*—Some remarks are made about the Minkowski space-time vector of the 2nd kind, $\Phi = (f_{ij})$, where Φ is a skew matrix, of order 4, whose 6 elements are the components of the electric and magnetic fields. Φ satisfies

$$\Phi^4 + Q\Phi^2 + P^2 = 0$$

and P,Q are rational invariants. L. S. G.

538.3 : 530.145 : 537.1

6338. Vacuum polarisation. MA, S. T. Letter in *Phys. Rev.*, **75**, 1264–5 (*April* 15, 1949).—The induced charge-current due to the polarization of the vacuum is evaluated in the Schwinger electromagnetic theory by methods similar to usual calculations in radiation problems, in order to resolve some of the ambiguities in the evaluation of the integrals. The result includes divergent integrals, one of which spoils the co-variance of the answer and also the gauge invariance. A finite covariant expression is obtained by amending the Hamiltonian. G. J. K.

538.31

6339. Relativistic interpretation of electrodynamic action. MALATESTA, S. *Acta Pont. Acad. Sci.*, **9** (*No.* 3) 21–6 (1945) *In Italian.*—Two pencils of electrons move in parallel streams. The interaction between these is examined. This leads to the consideration of the action between currents flowing in two parallel conductors. A formula for the action is deduced. L. S. G.

538.566

6340. On Sommerfeld's "radiation condition." ATKINSON, F. V. *Phil. Mag.*, **40**, 645–51 (*June*, 1949). —In problems of wave motion and diffraction involving an infinite medium the equations of wave motion and the boundary conditions do not uniquely determine the solution. Sommerfeld imposed additional restrictions on the behaviour of the wave at infinity. It is here rigorously demonstrated that these restrictions, or an equivalent set, make the solution unique. L. S. G.

538.566 : 621.392.26

6341. Electromagnetic waves in waveguides and related problems. BUCHHOLZ, H. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Appl. Math., Pt. V*," 81–7. *In German.*—A summary, mostly of the author's previous papers. Subjects include: (1) the magnetic coupling between 2 coaxial

current rings; (2) attenuation in guides of circular section; (3) radiation inside a parabolic cylinder, or an infinitely long paraboloid; (4) diffraction of a plane wave by a semi-infinite plane. L. S. G.

538.566 : 621.396.11 : 621.392.26

6342. Wave propagation in a guide of almost circular section. JOUGUET, M. *C.R. Acad. Sci., Paris*, **226**, 1436–8 (*May* 3, 1948) *In French.*—The section of the guide is represented by

$$r = R + \delta R + R\sum_{n=1}^{\infty} a_n \cos n\phi + b_n \sin n\phi$$

δR, a_n, b_n corresponding to first-order deformations. In such a guide each E_p or H_p wave splits into two waves of slightly different structure and phase velocity. For $p = 0$ the first order effect vanishes; for $p \neq 0$ this effect depends only on a_{2p}, b_{2p}. L. P. (R)

538.566.2

6343. On electromagnetic diffraction through a plane screen. MILES, J. W. Letter in *Phys. Rev.*, **75**, 695–6 (*Feb.* 15, 1949).—A variational approach to the problem is presented, similar to Schwinger's treatment of wave-guide diffraction problems. An aperture impedance is defined as the ratio of the complex power transferred through the aperture to that predicted by geometrical optics, and an expression is given for its reciprocal, involving complex integration over the λ-spectrum. Diffraction through a slit and a circular aperture are considered as examples, and the results approach closely those given by the exact theory. L. P.

538.566.2

6344. On the propagation of electromagnetic waves perpendicular to any stratified medium. ABELÈS, F. *Rev. Opt.* (*Théor. Instrum.*) **28**, 279–87 (*May*, 1949) *In French.*—General expressions describing the above are derived for absorbing media in terms of matrices, each of whose components is a function of (*a*) the optical properties of, and the distance traversed in each layer; (*b*) the wavelength of the radiation. Transmission and reflection coefficients are deduced, and an analogy with a transmission line pointed out. The equivalence of a system of many layers to one consisting of two rather than one is discussed. A parallel is shown to exist between the original equations and the Hamiltonian energy function. R. A. W.

538.566.2 : 523.72

Characteristics of radiofrequency radiation on ionized gas. *See Abstr.* 5893

538.566.2 : 621.396.11

6345. The representation of radiation in an atmospheric duct by a sequence of virtual sources. KAHAN, T. AND ECKART, G. *C.R. Acad. Sci., Paris*, **228**, 304–5 (*Jan.* 24, 1949) *In French.*—In an earlier note [Abstr. 4899 (1949)] it was shown that at large distances, r, from an oscillating dipole the electromagnetic field due to propagation in an atmospheric duct varied as r^{-3} or as $r^{-\frac{1}{2}}$, depending on the height of the dipole and the wavelength of the radiation. In the present note the transition case between these two laws is briefly considered. W. J. G. B.

538.566.3 : 621.396.615.14

6346. Radiation of microwaves and their absorption in air. GINZBURG, V. L. *Bull. Acad. Sci. URSS, Sér. Phys.*, **11** (*No.* 2) 165–82 (1947) *In Russian.*—After discussing the limitations of klystrons and magnetrons (min $\lambda \sim 1$ mm) two principal methods for generation of 0·1 to 10 mm waves are reviewed, namely, systems with excited rotational spectra of molecules, distinguished by h.f. stability but yielding microwatt powers only, and the more promising method of utilizing rapidly moving radiators (Doppler effect). The simplest way to produce this Doppler frequency multiplication is to place a fast electron in an electric field and to cause it to oscillate in a direction $\perp$ its velocity. A numerical example shows that with 5 MeV applied, oscillations of $\lambda = 20$ cm can be converted into radiation at $\lambda = 1$ mm. A mathematical analysis of this relativistic electron radiation is presented, and the practical difficulties of obtaining electron bunches required by energy considerations are indicated. It is shown that electrons moving along a dielectric surface at a distance $< \lambda$ radiate in the same way as if travelling in the medium and hence require much less acceleration (with $\varepsilon > 50$, 10–100 keV instead of MeV's). A detailed investigation of the absorption effects of mm waves, both theoretical and experimental, shows that, neglecting secondary absorption effects due to isotope molecules, absorption by air takes place around $\lambda = 2$ mm and by water vapour in a wide band with a max. at 1·3 cm. A. L. (R)

538.569.4 : 621.384.6 : 534.533

R.f. absorption by gas in the presence of a magnetic field. *See Abstr.* 6242

MAGNETIC EFFECTS 538.6

538.653.

6347. Possible magnetic field of a rotating metallic body containing a stress gradient. BENFIELD, A. E. Letter in *Phys. Rev.*, **75**, 211–13 (*Jan.* 1, 1949).—Electrons might be expected to flow from a compressed part of the body. A small radial charge separation could then be produced in a conductor by its own gravitational field. The rotation of such a body would generate a magnetic field. R. A. N.

THEORY OF SOLID STATE 539.11

539.11 : 536.7

On a new equation of state. *See Abstr.* 6176

539.11 : 537.311 : 548.1

Some electronic properties of a one-dimensional crystal model. *See Abstr.* 6555

MOLECULAR STRUCTURE 539.13

539.13

6348. On the ground state of the hydrogen molecule. ISIGURO, E. *J. Phys. Soc. Japan*, **3**, 129–32 (*March*

une, 1948) *In English.*—The energy is calculated for interatomic distances, using only those functions involving an odd power of the interelectronic distance, rom the set of functions used by James and Coolidge Abstr. 198 (1934)] since these form a complete set y themselves. For a given approximation the lectronic repulsion energy is < in the calculation of ames and Coolidge, and the series does not converge s rapidly as theirs. G. J. K.

539.132

349. Interaction terms in the potential functions for olyatomic molecules. TORKINGTON, P. Letter in *Nature, Lond.*, **164,** 186 (*July* 30, 1949).—The suggestion that interaction terms in the potential functions or polyatomic molecules are derived from the changes n bond hybridization accompanying nuclear displacements is examined in regard to ethylene, vinyl hloride and vinylidene chloride. W. R. A.

539.132

350. The computation of wave functions in momenum space. II. The hydrogen molecule ion. MCWEENY, R. *Proc. Phys. Soc. Lond. A*, **62,** 519–28 (*Aug.*, 949).—See Abstr. 6370 (1949). A new approach is nade to the problem of computing accurate momenum distribution functions for electrons in molecules. he usual molecular orbital wave function (linear ombination of atomic orbitals) has already been mployed for this purpose but has proved inadequate n attempts to explain the width of the Compton rofile. Using the method of the previous paper, the .c.a.o. type of molecular orbital is formally corrected y iteration. In most cases it seems likely that the orrected orbital will be associated with a greater pread of the momentum distribution and will thus ead to a broader Compton profile: the broadening hould become more marked with increasing delocalization of the electron and may apparently be very considerable. A complete calculation has confirmed these conclusions in the case of the hydrogen molecule ion: a preliminary treatment of the neutral molecule is given. A.

539.132 : 519.41

351. Symmetry species of overtones of degenerate vibrational fundamentals. DECIUS, J. C. Letter in *J. Chem. Phys.*, **17,** 504–5 (*May*, 1949).—These species are derived from group theory in a closed form. D. H. W.

539.132 : 541.5

6352. Directed valence as a property of determinant wave functions. ZIMMERMAN, H. K., JR. AND VAN RYSSELBERGHE, P. *J. Chem. Phys.*, **17,** 598–602 (*July*, 1949).—Making use of Slater's extension of the Heitler–London method, it is shown that the directional properties of C valences are a logical consequence of the combination of the H-like individual electron orbitals of C into a determinant wave function. It is possible to separate the radial and angular parts of such a function by factoring. Partial differentiation of the factored function with respect to the angular variables leads to proof of the directional properties, while partial differentiation with respect to the radial variable shows that, as long as all valence electrons are at equal distances from the nucleus, the electron density is maximum at points located on a sphere whose radius is calculated. A.

539.132 : 541.57

6353. A geometric approach to the theory of the carbon-carbon bond. ZIMMERMAN, H. K., JR. *J. Chem. Phys.*, **17,** 595–8 (*July*, 1949).—A geometric method of constructing the C–C bonds is described. It is postulated that there exists a region of high, constant electron density between the bound atoms. Calculations based on this postulate confirm it in that they lead to screening constants which are in fair agreement with the values given by Pauling and that plots of the variation of electron density with changes in the angular or radial variables reflect just such a region. Further, the plots are in good qualitative agreement with the well-known properties of rotation about a single bond and lack of rotation about a double bond. A.

539.132 : 541.571

6354. Evaluation of the force constants of bonds involving hydrogen atoms. TORKINGTON, P. Letter in *Nature, Lond.*, **164,** 113 (*July* 16, 1949).—A simple procedure is given for estimating the variation of the vibration frequency associated with a H-bond due to kinetic energy coupling with other atoms. G. J. K.

539.133

6355. The electric moments of some aromatic fluorine compounds. FRIESER, H., HOBBS, M. E. AND GROSS, P. M. *J. Amer. Chem. Soc.*, **71,** 111–15 (*Jan.*, 1949).

539.133

6356. The electronic state of the methylene radical. LAIDLER, K. J. AND CASEY, E. J. Letter in *J. Chem. Phys.*, **17,** 213–14 (*Feb.*, 1949).—The known singlet nature of the ground state of CH_2 shows that it is best described by a $(1s)^2(2s)^2(2p_x)^2(2p_y)^2$ electronic structure rather than one involving *sp* hybridized orbitals. D. H. W.

539.133

6357. Dipole moments and the molecular structure of pentaerythritol tetranitrate. SPRINGALL, H. D. AND SPEDDING, H. Letter in *Research, Lond.*, **2,** 295–6 (*June*, 1949).—In pentaerythritol tetranitrate Booth and Llewellyn [*J. Chem. Soc.*, 837 (1947)] found an anomalously short distance (1·37 ± 0·03 Å) between C and O in the C–O–N linkage. It is claimed that their suggested explanation (C–O bond partially double) would lead to a zero dipole moment; it is in fact large. A. J. C. W.

539.133

6358. A general method of obtaining molecular symmetry coordinates. NIELSEN, J. R. AND BERRYMAN, L. H. *J. Chem. Phys.*, **17,** 659–62 (*July*, 1949).—A general method of obtaining molecular symmetry co-ordinates based on the algebra of group representation theory is described. The method is direct and involves no trial and error. It presupposes a knowledge of the irreducible representations of the molecular symmetry group rather than merely of their characters. The orthogonality properties of the symmetry coordinates are derived. As an example, the method is

applied to BF_3 (D_{3h}), with the use of both internal and Cartesian co-ordinates. A.

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15 : 53.081.6

6359. Magnitudes and energy measurements in atomic physics. STILLE, U. *Z. Phys.*, **125** (*Nos* 1–3) 174–209 (1948) *In German.*—A general review of the determinations of the physical constants, with particular attention to N, F and h/e. A table is given of the "best" values of the constants, together with numerous quantities derived from them and of interest in atomic and nuclear physics. The values are almost identical with those recommended by Dumond and Cohen [Abstr. 2515 (1948)], though not in general given to as many significant figures. A. P. F.

539.152.1

6360. On the nuclear electric quadrupole moment of Li^6. KUSCH, P. Letter in *Phys. Rev.*, **75**, 887–8 (*March* 1, 1949).—Molecular beam magnetic resonance measurements on Li halides show resolved peaks for Li^7 resulting from the nuclear quadrupole moment interaction, while Li^6 compounds show much narrower lines indicating a moment $\leqslant \pm 0{\cdot}88\times10^{-27}$ cm² if that of Li^7 is -2×10^{-26} cm². The Li^6 nucleus must be in a nearly pure S state. D. H. W.

539.152.1 : 530.145

On nucleon moments and the neutron-electron interaction. *See Abstr.* 5949

539.152.2

6361. Nuclear gyromagnetic ratios of Be^9, Rb^{85}, Rb^{87}, and Cs^{133}. ZIMMERMAN, J. R. AND WILLIAMS, D. Letter in *Phys. Rev.*, **75**, 699 (*Feb.* 15, 1949).—g values of 0·783, 0·536, 1·83, 0·734 respectively were observed by magnetic resonance absorption. D. H. W.

539.152.2

6362. Nuclear magnetic relaxation in solids. DARBY, J. F. AND ROLLIN, B. V. Letter in *Nature, Lond.*, **164**, 66–7 (*July* 9, 1949).—The proton spin relaxation times in some alums with a small amount of added paramagnetic salt are shown to be $<$ in the pure non-paramagnetic salts at temps. below 90°K. The shorter times are those for exchange of the nuclear spin energy with the electron spin systems rather than directly with the lattice. D. H. W.

539.152.2

6363. Nuclear moments of silver. CRAWFORD, M. F., SCHAWLOW, A. L., GRAY, W. M. AND KELLY, F. M. Letter in *Phys. Rev.*, **75**, 1112 (*April* 1, 1949).—The AgI resonance line (3281Å) is excited in an atomic beam light source and its hyperfine structure resolved with an Al-coated Fabry-Perot etalon. The structure observed agrees with that reported by Jackson and Kuhn from absorption measurements [see Abstr. 679 (1939)]. The nuclear magnetic moments of the two isotopes have been evaluated, using the Goudsmit formula, and—after certain corrections—are given as $\mu(Ag^{107}) = -0{\cdot}086$ and $\mu(Ag^{109}) = -0{\cdot}159$ nuclear magneton. A. H.

539.152.

6364. Nuclear magnetic resonance in weak fields. BROWN, R. M. AND PURCELL, E. M. Letter in *Phys. Rev.*, **75**, 1262–3 (*April* 15, 1949).—Nuclear magneti resonance was observed at 50 kc/s in a field o 11·7 gauss in water with a width of $<$ 7 milligauss The low field produced in a 1 ft dia. solenoid i homogeneous, allowing the small width to be observe better than at higher field strengths. D. H. W

539.152.

6365. Erratum: Study of phase transitions by mean of nuclear magnetic resonance phenomena. ALPERT N. L. Letter in *Phys. Rev.*, **75**, 1271 (*April* 15 1949).—See Abstr. 2646 (1949).

539.152.

6366. On the interaction of nuclear spins in a crystalline lattice. BLOEMBERGEN, N. *Physica* **15**, 386–426 (*May*, 1949) *In English.*—The exchange o energy between a system of nuclear spins, immersed i a strong magnetic field H_0, and the lattice vibrations o insulating crystals has been investigated experi mentally by the method of nuclear magnetic resonanc absorption. The resonance in CaF_2, some hydrate sulphates and some alkali halides, has been observe between 300°K and 1°K, at 30·5 and 9·5 Mc/s The measured spin-lattice relaxation times T_1 range from 10^{-3} to 10^4 sec, and disagree violently—in many cases by more than a factor 10^6—with Waller' theory of paramagnetic relaxation. It is shown tha the relaxation time T_1 is determined by paramagneti impurities occurring in the lattice. An order o magnitude theory is developed taking these impurities into account. The quanta absorbed by the system o nuclear spins from the external radiofrequency fiel diffuse toward the impurities. The energy is then transferred to the lattice vibrations via the fluctuating magnetic field from the impurity. The first proces depends on the concentration of the impurities, the second on H_0 and on the relaxation time ρ of the impurity. The experimental data receive at leas qualitative explanation in terms of these quantities In some cases a direct heat contact between the system of nuclear spins and the system of impurity spin proves to be important. Then T_1 is independent o the lattice temp. A

539.152.2 : 537.1

6367. Measurement of the proton in absolute units. THOMAS, H. A., DRISCOLL, R. L. AND HIPPLE, J. A Letter in *Phys. Rev.*, **75**, 902–3 (*March* 1, 1949).—By observing the proton nuclear resonance in water in a uniform stabilized field of 5 000 gauss whose value was accurately determined from the force on a current-carrying wire, the gyromagnetic ratio of the proton was found to be $2{\cdot}6752 \pm 0{\cdot}0002$ in excellen agreement with the value of Millman and Kusch i the radiative correction to the electron moment i applied. Assuming $h = 6{\cdot}6234 \pm 0{\cdot}0011\times10^{-27}$ erg sec, the proton moment is $1{\cdot}4100 \pm 0{\cdot}0003\times10^{-2}$ gauss cm³. D. H. W

539.153 : 535.338.3

Determination of the population of atomic levels *See Abstr.* 6091

539.153.4 : 535.338.1

68. Normalized wave-functions for different states the valency electrons and oscillator strengths for nsitions between them, for Na I, K I, Mg II, Si II l Al I. BIERMANN, L. *Nachr. Wiss. Göttingen o.* 2) 116–18 (1946) *In German.*—The relevant antities, some of which are the results of new culations [see also *Z. Astrophys.*, **22**, 157 (1943)] tabulated. R. F. B.

539.153.4

69. Analytical expression of self-consistent wave nctions for lithium, boron, carbon and oxygen. UTIHASI, S. *J. Phys. Soc. Japan*, **3**, 135–6 (*March–ne*, 1948) *In English.*—Expressions are obtained by ater's method [Abstr. 90 (1933)] up to 3*p* electrons r Li and 2*p* for the others. G. J. K.

539.153.4

70. The computation of wave functions in momen-m space. I. The helium atom. MCWEENY, R. AND OULSON, C. A. *Proc. Phys. Soc. Lond. A*, **62**, 9–18 (*Aug.*, 1949).—The possibilities of obtaining ecise momentum wave functions for atoms by direct lution of the wave equation in momentum space e examined in some detail. An iterative method of proximating to the wave function is employed in mputing the momentum distribution function for e He atom. Although in this instance considerable curacy is achieved, formidable difficulties arise in tending the calculations to more complicated oms. See Abstr. 6350 (1949). A.

539.153.4 : 535.338

71. Doublet-intervals of lithium I, boron I and ygen IV. TUTIHASI, S. *J. Phys. Soc. Japan*, **3**, 7–8 (*March–June*, 1948) *In English.*—The $^2P_{3/2} - {}^2P_{\frac{1}{2}}$ tervals for configurations containing one *p*-electron utside closed shells were calculated on the basis of raki's formula [see Abstr. 167 (1940)]. Self-nsistent radial functions were used. Results are fair agreement with experiment. L. P.

539.153.4 : 535.338.3

72. On atomic energy levels of $p^n l$ configurations. AMANOUCHI, T. AND AMEMIYA, A. *J. Phys. Soc. pan*, **1**, 18–23 (*July–Dec.*, 1946) *In English.*—evious calculations are extended to give the energies states where an electron with angular momentum added to a core (p^n) of electrons. [See also Abstr. 22 (1938)]. G. J. K.

539.154

73. Recent changes and additions in the con-stency diagram of the natural atomic constants. U MOND, J. W. M. Letter in *Phys. Rev.*, **75**, 1267 *April* 15, 1949).—Recent accurate determinations of me atomic constants are discussed in the light of a art previously used [Abstr. 2515 (1948)] to check eir internal consistency. E. P. G.

539.155

74. The determination of the mass of N_7^{16} by eans of interpolation. SZELENYI, T. Z. Letter in *hys. Rev.*, **75**, 1105–6 (*April* 1, 1949).—The observed ass-defect differences for the light 4*n* type isobars = 4, 8, 12 . . . 36) are plotted against the mass umber *A*. A smooth curve results, from which a mass-defect difference of 9·4 ± 0·6 mMU is deduced, by interpolation, for the point $A = 16$. The mass-defect of O^{16} is known to be 136·61 ± 0·2 mMU, whence that of N^{16} is deduced to be 127·2 ± 0·7 mMU, corresponding to an atomic mass of 16·0102 ± 0·0007 MU. L. R. S.

539.155.2

6375. Natural abundance measurements on germanium. HIBBS, R. F., REDMOND, J. W., GWINN, H. R. AND HARMAN, W. D. Letter in *Phys. Rev.*, **75**, 533–4 (*Feb.* 1, 1949).—GeF_4 (via capillary leak) and GeI_4 (by distillation) were admitted into a mass spectrometer. New relative abundance values for the 5 Ge isotopes were determined, using GeF_3^+ and GeI^+ ions. T. G. P.

539.155.2

6376. The isotopic constitution of dysprosium. INGHRAM, M. G., HAYDEN, R. J. AND HESS, D. C., JR. Letter in *Phys. Rev.*, **75**, 693–4 (*Feb.* 15, 1949).—Dy_2O_3 purified in an ion exchange column and analysed in a filament source mass spectrometer with vibrating reed electrometer as detector gave the percentage abundances:

$A =$	156	158	160	161
	0·0524	0·0902	2·294	18·88
	±0·0005	±0·0009	±0·011	± 0·09
$A =$	162	163	164	
	25·53	24·97	28·18	
	± 0·13	± 0·12	± 0·14	

154, 155, 157, 166 < 0·002; 159 < 0·008; 165 < 0·011. The calculated chemical atomic weight is 162·51 (chemically determined value 162·46). A. O. S.

539.155.2

6377. Mass defects of the lightest nucleons. WAPSTRA, A. H. *Physica*, **15**, 380–5 (*May*, 1949) *In English.*—Least squares methods are used to obtain the mass defects of some light isotopes, combining data from the mass spectrograph and from nuclear reactions. A.

539.155.2

6378. Some possible rare stable isotopes. DUCKWORTH, H. E. Letter in *Phys. Rev.*, **75**, 1438 (*May* 1, 1949).—Examination of the (linear) plot of *A* against *Z* for the lightest known [stable] isotopes of elements of even *Z* (46–82) suggests that Te^{118}, Gd^{150} and Pt^{190} may exist as rare stable isotopes. [See Abstr. below.] A. O. S.

539.155.2

6379. A new stable isotope of platinum. DUCKWORTH, H. E., BLACK, R. F. AND WOODCOCK, R. F. Letter in *Phys. Rev.*, **75**, 1438–9 (*May* 1, 1949).—Using a spark ion source and double focusing mass spectrograph, evidence was obtained for the existence of the isotope Pt^{190} (abundance 6×10^{-5}). [See Abstr. above]. A. O. S.

539.155.2

6380. "Heat flush" method of He^3 separation. REYNOLDS, C. A., FAIRBANK, H. A., LANE, C. T., MCINTEER, B. B. AND NIER, A. O. *Phys. Rev.*, **76**, 64–6 (*July* 1, 1949).—A further experimental study has been made of the efficiency of separation of He^3

from mixtures of He^3 and He^4 in a method making use of the "internal convection" process in superfluid liquid helium. It is shown that the method is capable of removing all the He^3 in mixtures with an original He^3/He^4 abundance of 10^{-2}% in a period of about five minutes with a power input of 13 milliwatts. The efficiency of the method as a function of power input is also studied and comparison is made with Kapitza's measurements on the "latent heat" of superfluid atoms. A.

539.155.2 : 541.127

An effect of isotopic mass on the rate of a reaction. *See Abstr.* 6491

539.155.2 : 541.135

An electrochemical exchange method [of isotope separation]. *See Abstr.* 6497

539.155.2 : 550.93

World wide assay of natural radiocarbon. *See Abstr.* 6590

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.163

6381. Development in radioactive tracer methods. Arrol, W. J. *Research, Lond.*, **2**, 253–9 (*June*, 1949).—A review article of the techniques used in biology and chemistry. B. R.

539.163

6382. Hf^{175}, a new radioactive isotope of hafnium. Wilkinson, G. and Hicks, H. G. Letter in *Phys. Rev.*, **75**, 696–7 (*Feb.* 15, 1949).—Produced by 19 MeV deuterons or 10 MeV protons on Lu. The half-life is 70 ± 2 d. The activity consists of electrons, X-rays and γ-rays, whose energies were determined by absorption methods, and relative intensities estimated. The cross-section for formation by deuterons is 3×10^{-2} barn, by protons 5×10^{-2} barn. B. R.

539.163

6383. Measurement of the half-life and average energy of tritium decay. Jenks, G. H., Ghormley, J. A. and Sweeton, F. H. Letter in *Phys. Rev.*, **75**, 701–2 (*Feb.* 15, 1949).—The ½-life was found to be $12{\cdot}46 \pm 0{\cdot}2$ yr by measurement of the evolution of He^3. The average energy was determined calorimetrically to be $5{\cdot}69 \pm 0{\cdot}06$ keV. B. R.

539.163

6384. Characteristics of 16·5-minute Y^{94}. Brown, L. J. and Katcoff, S. Letter in *J. Chem. Phys.*, **17**, 497–8 (*May*, 1949).—Y^{94} was isolated from fission products of U and Pu. Separation from rare-earth fission products was accomplished by two methods, one based upon the greater range of the Y recoil fragments, the other involving a short irradiation of uranyl nitrate solution (3 min), followed quickly by removal of Ba, Y and rare earth activities by precipitation of $BaCrO_4$ and LaF_3, Y^{94} then being allowed to grow from the 2 min Sr parent left in the solution. The mean ½-life of the Y^{94} decay was found to be $16{\cdot}5 \pm 1{\cdot}0$ min, from observations on both γ- and β-rays. Al absorption curves for the β-rays indicate, by the Feather method, a range of 2 800 mg/cm corresponding to an end-point of 5·4 MeV. H absorption of the γ-rays gave an energy of 1·4 MeV L. R.

539.16

6385. Measurements on radioactive krypton isotope from fission after mass-spectrographic separation Koch, J., Kofoed-Hansen, O., Kristensen, P. an Drost-Hansen, W. *Phys. Rev.*, **76**, 279–82 (*July* 1 1949).—Radioactive isotopes of Kr resulting fro fission of U have been separated in a mass-spectro graph. The ½-lives and the relative fission yields o the isotopes Kr^{85}, Kr^{87} and Kr^{88} have been measure The max. energies of the β-particles from Kr^{85} an Kr^{87} have been checked by absorption. It has bee shown that Kr^{88} emits soft β-particles and an intens γ-radiation. This result combined with othe measurements indicates that the β-spectrum of Kr is complex. A

539.16

6386. Coincidence and absorption investigation o the disintegration of Rh^{106}, Sb^{125}, and Pr^{142}. Jurney E. T. *Phys. Rev.*, **76**, 290–2 (*July* 15, 1949).—Th disintegration of Rh^{106}, Sb^{125} and Pr^{142} has bee studied with the help of conventional absorption an coincidence counting techniques. All three isotope exhibit complex β-ray spectra, on the basis of th shapes of their β–γ coincidence plots. A definit γ–γ coincidence rate indicates cascaded γ-rays in all the disintegration schemes. Corrections fo coincidences between γ-rays and X-rays resultin from internal conversion are discussed for the case o Sb^{125}. A

539.163.1 : 539.172.1

6387. Radioactive thallium isotopes produced from gold. Orth, D. A., Marquez, L., Heiman, W. J. and Templeton, D. H. Letter in *Phys. Rev.*, 75 1100 (*April* 1, 1949).—Periods of 1·8, 7 and 27 hr ascribed to Tl^{198}, Tl^{199} and Tl^{200} respectively, were obtained by bombardment of Au with 38 MeV H ions. Particles, *L*-X-rays and γ-rays were observe in all 3 periods. B. R

539.163.

6388. Disintegration of Hg^{203}. Slätis, H. and Siegbahn, K. *Ark. Mat. Astr. Fys.*, **36 A** (*Paper* 21 1–11 (1949) *In English*.—The β- and γ-radiation from Hg^{203}, activated in the Oak Ridge pile, were studied by means of absorption measurements magnetic spectrometers and β–γ coincidence spectrometer. The upper limit of the β-spectrum was found to be 208 keV and the energy of the γ-ray 279 ± 2 keV in agreement with Saxon's values. The *K*-, *L*- and *M*-conversion lines and also the *K*-, *L*- and *M*-photo lines released in Pb by the γ-radiation were resolved X-radiation ($E \simeq 70$ keV), originating in the refilling of the *K*-shells after the emission of *K*-internal conversion electrons, was observed in absorption measurements as well as in β–γ coincidence spectrum. The internal conversion coeff. was estimated to be 27%. The disintegration of Hg^{20} leads to the same excited level of 279 keV energy in Ta as the *K*-capture by Pb (52 hr). The mass assignment for Hg (43·5 d) is 203, which therefore has to be assumed also for 52 hr Pb. A

539.163.2

89. Search for nuclear isomers with half-lives tween a millisecond and a second. HOLMES, J. E. R., EI, J. Y. AND TURGEL, R. S. Letter in *Phys. Rev.*, , 889 (*March* 1, 1949).—Method similar to that of ahmias and Walen [Abstr. 2301 (1937)] with gative results for the elements examined (Li, B, l, Ni, Cu, Rh, Ag, Cd, In, Sm, Eu, Gd, Dy, Ir, Au, g). R. B. S.

539.163.2

90. Radioactive gadolinium and terbium isotopes. UTEMENT, F. D. S. Letter in *Phys. Rev.*, **75,** 76 (*April* 15, 1949).—Three activities of ½-lives 8 ± 5 sec, 18·0 ± 0·2 hr and 6·75 ± 0·1 d are oduced by neutron irradiation of Ga. The cross-ctions for the production of these activities was termined by a pile activation method and the and γ-radiations studied by the absorption chnique. The cross-sections for the 218 sec and 75 d activities are the same within the limits of perimental error and it is suggested that the 6·75 d tivity is due to β-decay of Tb^{161}, following the sintegration of a 218 sec isotope Gd^{161}. The 8 hr activity is probably due to the decay of Gd^{159}. he 6·75 d isotope was also produced by proton and euteron bombardment of Gd, together with a 5·9 d tivity, emitting low energy electrons and γ-rays. his is believed to be a new isotope of Tb which ecays by orbital electron capture. L. R. S.

539.163.2

391. Radiation from 225 day Ag^{110}. SIEGBAHN, K. etter in *Phys. Rev.*, **75,** 1277 (*April* 15, 1949).—The - and γ-radiations from Ag^{110} were investigated in a rge double focusing β-spectrometer. Ten different -ray energies were revealed by the internal conver-on electrons and the photoelectron spectrum from a in Pb radiator, ranging from 116 keV to 1·516 MeV. nalysis of the β-spectrum showed the presence of ain components with end points at 87 keV and 30 keV and a weak component of end point ·79 MeV. There are indications of further com-lexity in the β-spectrum between the 87 keV and 30 keV end points. L. R. S.

539.163.2

392. The nuclear spectra of Sb^{125}, Te^{125*}, Cr^{51}, nd I^{131}. KERN, B. D., MITCHELL, A. C. G. AND AFFARANO, D. J. *Phys. Rev.*, **76,** 94–100 (*July* 1, 949).—The nuclear spectra of Sb^{125}, Te^{125*}, Cr^{51} and ^{31} have been measured with a magnetic lens spectro-eter. Sb^{125} has a β-ray end point at 0·621 MeV, a ower energy group at 0·288 MeV, and perhaps some oups of still lower energy. The γ-rays of Sb^{125} are 0·125 (I.C.), 0·174 (I.C.), 0·431 (I.C.), 0·466, ·609 (I.C.), and 0·646 MeV. Those marked with ie notation (I.C.) are internally converted. The etastable state of Te^{125}, daughter of Sb^{125}, is haracterized by the emission of an internally con-erted γ-ray of energy 0·110 MeV. Cr^{51} emits no ositrons but decays by *K*-capture accompanied by γ-rays of energies 0·323 and 0·267 MeV, the latter eing entirely internally converted. I^{131} has a β-ray ad point of 0·605 MeV with a lower energy group 0·250 MeV. γ-rays at 0·080, 0·282, 0·363 and ·637 MeV are observed. The disintegration schemes f Sb^{125}, Te^{125*} and I^{131} are discussed. A.

539.163.2

6393. The properties of 86-second I^{136}. STANLEY, C. W. AND KATCOFF, S. *J. Chem. Phys.*, **17,** 653–8 (*July*, 1949).—A short-lived I which was discovered by Strassmann and Hahn as a U fission product was shown to have a ½-life of 86 ± 1 sec. It emits 6·5 MeV β-rays and 2·9 MeV γ-rays. The fission yields in U^{235}, Pu^{239} and U^{233} are 3·1, 1·9 and 1·7%, respectively. A mass assignment to 136 has been shown to be the most likely one. The observed 86 sec I activity does not originate from a Te parent whose ½-life is > 20 sec. A.

539.163.2

6394. Alpha-radioactivity in elements lighter than bismuth. BALLOU, N. E. Letter in *Phys. Rev.*, **75,** 1105 (*April* 1, 1949).—It is suggested that α-emission may compete with β-emission for certain medium nuclei. Attempts to detect α- and β-activity of Ti^{44} and Zr^{88} were unsuccessful. B. R.

539.163.2

6395. The beta-spectrum of Be^{10}. HUGHES, D. J., EGGLER, C. AND HUDDLESTON, C. M. *Phys. Rev.*, **75,** 515–18 (*Feb.* 1, 1949).—The ½-life of Be^{10} determined from all available data is $2·7 \pm 0·4 \times 10^6$ yr. The end point and shape of the β-spectrum were determined by an absorption method. An expression is given for deriving the energy distribution of the β-spectrum of a source, from the absorption curve obtained with the source in a given counter geometry. According to this expression, the absorption curve for a continuous β-spectrum should fall off as the 4th power of the residual range so that a plot of the 4th root of the counting rate against absorber thickness should yield a straight line. The results obtained for a W^{185} source were in good agreement with this rule. The energy end point for W^{185} is accurately known and that for Be^{10} was derived by comparison with the absorption curve for these 2 sources. A value of 570 ± 10 keV was obtained. The β-spectra of Cu^{64}, Au^{198}, W^{185} and RaE were derived from absorption curves and compared with the known spectra. The spectra obtained in this way differed slightly from the true spectra, but it was found possible to bring them into agreement with a simple correction. The procedure was applied to Be^{10} and the spectrum so obtained was found to be of the allowed shape. γ-radiation from Be^{10}, if any, is much weaker than one quantum per β-particle. L. R. S.

539.163.2

6396. On the beta-particle spectrum from the decay of tritium. BYATT, W. J., ROGERS, F. T., JR. AND WALTNER, A. Letter in *Phys. Rev.*, **75,** 908–9 (*March* 1, 1949).—Reduction of the data given in Abstr. 4134 (1949) gives the extrapolated end-point energy of the β-particle spectrum as 17·0 keV. [Cf. Abstr. 3887 (1948)]. R. B. S.

539.163.2

6397. The β-spectrum of H^3. HANNA, G. C. AND PONTECORVO, B. Letter in *Phys. Rev.*, **75,** 983–4 (*March* 15, 1949).—The shape and energy end-point of the spectrum were determined, using proportional counters and pulse analyser. H containing H^3

formed part of the counter fillings. Gas multiplication factors of several thousand were employed and energy calibration obtained from 17·4 keV Mo $K\alpha$ X-rays and 2·8 keV X-rays from the decay of A^{37}, which formed part of the filling of one counter. Wall effects were negligible, but reduced multiplication at the ends of the counter caused spurious low amplitude pulses, affecting the low energy region of the spectrum (< 5 keV). The shape of the upper region of the tritium β-spectrum appeared to conform to Fermi's theory for zero neutrino mass. The end-point energy was found to be $18{\cdot}9 \pm 0{\cdot}5$ keV. L. R. S.

539.163.2

6398. Energy of beta-rays from K^{40}. Floyd, J. J. and Borst, L. B. Letter in *Phys. Rev.*, **75**, 1106 (*April* 1, 1949).—The max. energy of β-particles emitted by K^{40} has been determined by the absorption method, using a sample of K enriched 100-fold in K^{40}. The absorption curve of the β-particles in Al was found to have an end-point of 625–700 mgm/cm² corresponding to an energy of $1{\cdot}45 \pm 0{\cdot}15$ MeV. The ratio of γ-rays to β-particles emitted by K^{40} was determined, using Na^{40} as a calibration source. A value of $0{\cdot}05 \pm 0{\cdot}01$ γ-rays per β-particle was obtained. The disintegration constant of the K^{40} β-decay was found to be $4{\cdot}3 \pm 0{\cdot}4 \times 10^{-10}$ yr^{-1}. L. R. S.

539.163.2

6399. Radioactivity of K^{40}. Stout, R. W. Letter in *Phys. Rev.*, **75**, 1107 (*April* 1, 1949).—The β-radioactivity of K^{40} was determined by observation of the β-counting rates, with KCl sources, containing standardized quantities of Na^{24}. Counts were taken over a period, during which the Na^{24} decayed from initial values about 30 times that of the K^{40} to negligible proportions, whence the ratio of the K^{40} β-activity to that of the Na^{24} at some initial time, was obtained. The counting efficiency was assumed to be the same for Na^{24} and K^{40} β-particles, in view of the similarity of their absorption spectra. The specific activity of K^{40} was found to be $30{\cdot}6 \pm 2{\cdot}0$ β/sec/g of natural K. L. R. S.

539.163.2

6400. The beta-ray spectra of Cu^{64} and the ratio of N^+/N^-. Wu, C. S. and Albert, R. D. Letter in *Phys. Rev.*, **75**, 1107–8 (*April* 1, 1949).—The Kurie plots of the positron and negatron spectra of Cu^{64}, obtained with a thin uniform source, has been replotted after making a screening and relativistic correction to the Coulomb factor. It is found that the deviation from a straight line plot begins at about 130 keV for the negatrons and 140 keV for the positrons. At 50 keV the deviation from the straight line is $< 6\%$ for negatrons and $< 8\%$ for positrons. The ratio of positron to negatron emission is found to be in excellent agreement with the theory. L. R. S.

539.163.2

6401. Shape of the beta-spectrum of the forbidden transition of yttrium 91. Langer, L. M. and Price, H. C., Jr. Letter in *Phys. Rev.*, **75**, 1109 (*April* 1, 1949).—The momentum distribution of β-particles from 57 d Y^{91}, has been measured in a high resolution magnetic spectrometer, using extremely thin source and backing. The maximum kinetic energy of t β-particles is 1·53 MeV. A Kurie plot of the spectrum shows marked departure from the allow type of transition, but agrees perfectly with the sha predicted, by the theory, for a 1st forbidden transiti with $\Delta J = \pm 2$ and G–T selection rules. T transition had previously been classed as 2 forbidden. L. R.

539.163

6402. Disintegration of Cs^{137}. Peacock, C. and Mitchell, A. C. G. Letter in *Phys. Rev.*, 1272–4 (*April* 15, 1949).—The β spectrum of 33 Cs^{137} was measured in a 180° type of spectrome using a very thin source. The spectrum contains component of energy 0·521 MeV and relat abundance 95%, a component with an end point 1·2 MeV and internal conversion electrons due a γ-ray of energy 0·669 MeV. A Kurie plot of t β spectrum shows a wide departure from the allow distribution. The shape of the 0·521 MeV spectru corresponds to that predicted by the theory for a fi forbidden transition with $\Delta J = \pm 2$. L. R.

539.163

6403. The beta-spectrum of A^{41}. Brown, H. A Perez-Mendez, V. Letter in *Phys. Rev.*, **15**, 1276 (*April* 15, 1949).—The spectrum was observed in semicircular type of β-ray spectrometer designed use with gaseous sources. The gas was contained a chamber having a 2·5 mgm/cm² cellophane windo forming a source of equivalent thickness 0·7 mgm/cm The A^{41} activity was induced by bombardment of pu A gas with 8 MeV deuterons. A $\frac{1}{2}$-life of 107 ± 3 m and a β spectrum end-point of $1{\cdot}245 \pm 0{\cdot}010$ Me were obtained. The shape of the β spectrum co formed to that given by Fermi for an allow transition. L. R.

539.163

6404. Beta-ray spectrum of K^{40}. Alburger, D. Letter in *Phys. Rev.*, **75**, 1442–3 (*May*, 1949). Potassium enriched 100-fold in K^{40} has been examin in a magnetic lens spectrometer of 6 to 9% so angle and resolution 15%. The source consisted 74 mgm of KCl spread over 4 cm² on 4 mg/cm² mi Max. β counting rates were $<$ the backgrou A Fermi plot of the spectrum was linear abo 450 keV with an end-point at $1{\cdot}40 \pm 0{\cdot}03$ Me The Fermi plot of a P^{32} spectrum—which was us for calibration—was also linear down to 500 k and then departed from linearity in a manner simi to the K^{40} plot. For this reason it is assumed t the apparent deviation of the K^{40} plot from a strai line below 450 keV is due to scattering in the spect meter. L. R

539.16

6405. On the maximum β-energy release in tritiu Slack, L., Owen, G. E. and Primakoff, H. Let in *Phys. Rev.*, **75**, 1448 (*May* 1, 1949).—The value $5{\cdot}69 \pm 0{\cdot}06$ keV, obtained by calorimetric metho for the average β-energy release in the decay of [Abstr. 6383 (1949)] is shown on the basis of Ferm theory, to correspond to an end-point energy $18{\cdot}6 \pm 0{\cdot}2$ keV. The value $|M|^2 tf = 3\,360 \pm 2$ resulting from this end-point and the observ

life of 12·46 yr, is consistent with the value 6 300 ± 000 for the equally allowed He^6 decay. L. R. S.

539.163.2

406. Magnetic multipole internal conversion. OWEN, I. S. AND TRALLI, N. Letter in *Phys. Rev.*, 5, 529 (*Feb.* 1, 1949).—The results are given of lculations of the ratio of *K* and *L* conversion coeffs. r 2-, 4- and 6-pole magnetic radiation for all ergies > 40 keV at $Z = 35$. The values are mpared with those obtained using a less accurate rm approximation method. Differences of 10–15% are shown to arise at low energies. A. P. F.

539.163.2

407. On the numerical calculation of the internal nversion in the *K*-shell; the electric dipole case. RIFFITH, B. S. AND STANLEY, J. P. Letter in *Phys. ev.*, **75,** 534–5 (*Feb.* 1, 1949).—Values of the con- rsion coefficients have been calculated to 4 sig- ficant figures for $Z = 69$ to 89 at intervals of and for $\theta = mc^2/h\nu$ from 0 to 1·70. An erratum ppears in *Phys. Rev.*, **75,** 1110 (*April* 1, 1949). G. J. K.

539.163.2

408. The efficiency of the internal conversion ocess in Br^{80}. HAMILL, W. H. AND YOUNG, J. A. tter in *J. Chem. Phys.*, **17,** 215 (*Feb.*, 1949).— procedure for separating Br^{80} (18 min) from Br^{80} ·5 hr) is described and efficiencies of the internal nversion process are tabulated, in agreement with eory. There is no branching decay of Br^{80} and the emical effects produced correspond to complete nversion. C. B. A.

539.163.2

409. Gamma-rays from Na^{24} and V^{48}. ROBINSON, E., TER-POGOSSIAN, M. AND COOK, C. S. Letter in *hys. Rev.*, **75,** 1099 (*April* 1, 1949).—The γ-rays om Na^{24} and V^{48} were measured in a semicircular -ray spectrometer, by observing Compton and otoelectrons ejected from a 50 mgm/cm² U radiator. calibration of the spectrometer was provided by e annihilation radiation from V^{48}. The γ-ray ergies of Na^{24} were found to be 1·380 MeV and 765 MeV, while energies of 0·990 MeV and 320 MeV were obtained for the V^{48} γ radiation. L. R. S.

539.163.2

410. On the gamma radiation from I^{131}. MOE, D., WEN, G. E. AND COOK, C. S. Letter in *Phys. Rev.*, 1270–1 (*April* 15, 1949).—A spectrometer study the γ-rays from I^{131} was made, using a 50 mgm/cm² radiator. The photoelectron spectrum contained ominent *K* and *L* lines due to a strong γ radiation energy 364·18 keV, while weaker lines due to a 4·1 keV and 638 keV radiations were also detect- le. Two very weak lines at 1 080 gauss-cm and 380 gauss-cm were assumed to be respectively the line due to a 208 keV γ-ray and the *L* line due to a 9 keV radiation. Further observations after a se of two $\frac{1}{2}$-lives indicated that all the lines cayed with the I^{131} period. L. R. S.

539.164.2

411. On the Geiger–Nuttall relationship. BIS- AS, S. Letter in *Phys. Rev.*, **75,** 530–2 (*Feb.* 1, 49).—A refinement of the Geiger–Nuttall relation, sed on a square potential well and applied to isotopes of the same atomic number. For the isotopes of Po, the theoretical curve agrees with experiment over the middle energy range (6–8 MeV), but diverges at high and low energies. A. O. S.

539.164.2

6412. Relation between half-life and energy in alpha-decay. PERLMAN, I., GHIORSO, A. AND SEABORG, G. T. *Phys. Rev.*, **75,** 1096–7 (*April* 1, 1949).—A plot of $\log \lambda$ against E_α for even-even nuclei shows 7 nearly parallel lines for the elements from Po to Cm. Most nuclei with an odd proton and/or neutron have much longer $\frac{1}{2}$-lives than would be predicted from the diagram. The theoretical implications are discussed. B. R.

539.164.92

6413. Alpha-particle ionisation in argon and air and the range-energy curves. JESSE, W. P. AND SADAUSKIS, J. Letter in *Phys. Rev.*, **75,** 1110–11 (*April*, 1949).—Experiments on the relative ionization from Sm and Po α-particles in air and A have indicated that the α ionization in air is not $\propto$ the particle energy. The consequences of the necessary corrections to previous work are discussed. An attempt to correct the proton range/energy curve on the basis of these α-particle results leads to a derived value for the $(n - H^1)$ mass difference which is nearer to the Chalk River value of 0·804 MeV than to the previously accepted figure. G. O. B.

539.165 : 537.533.74

Error due to scattering in measurement of cloud chamber tracks in a magnetic field. *See Abstr.* 6254

539.165.08 + 539.166.08

6414. An instrument for energy determination of β and γ radiation. SIEGBAHN, K. AND SLÄTIS, H. *Ark. Mat. Astr. Fys.*, **36 A** (*Paper* 22) 1–24 (1949) *In English.*—This instrument, the "limegraph," is constructed from a toroidal G.M. counter, set up between the pole pieces of an electromagnet, with the field perp. to the plane of the toroid. The inner surface of the counter is covered with an Al foil window, which allows electrons to penetrate into the counter from a radioactive source at the centre of the toroid. The interior of the limegraph contains the same gas as the counter, the Al window serving only to define the boundary of the counter. Electrons from the source are constricted by the magnetic field to move in helical trajectories and they can reach the counter only when their momenta exceed a certain value determined by the magnitude of the field. An integrated spectrum of the electrons from the source is obtained from the variation of the counting rate with the magnetic field. The effective solid angle of the counter varies with the radius of curvature of the electron tracks, from 10% to 16%. End-points of β-spectra and Compton distributions can be determined. Variation of the effective solid angle and scattering of electrons in the gas-filled space of the limegraph modify the integrated spectra and have to be taken into account. The high transmission of the instrument permits the use of very weak sources. L. R. S.

539.166

6415. Bremsstrahlung in high energy nucleon-nucleon collisions. ASHKIN, J. AND MARSHAK, R. E.

Phys. Rev., **76**, 58–60 (*July* 1, 1949).—Formulae for the differential cross-sections for the continuous γ-emission accompanying proton-neutron, proton-proton, neutron-neutron collisions have been derived. Numerical results are given for an incident nucleonic energy of 250 MeV. A.

539.166

6416. Pair-production in different elements by γ-rays. Roy, R. R. *Proc. Phys. Soc. Lond. A*, **62**, 499–504 (*Aug.*, 1949).—The production of electron pairs on bombardment of Pb, Pt, Sn, Ag and Cu by γ-rays from 200 mg of Ra and its equilibrium products has been investigated. 1 200 photographs were taken for each element and the yield was 100 pairs in Pb, 85 in Pt, 72 in Sn, 63 in Ag and 50 in Cu. The distribution of energy of the positrons in Pb and Pt follows the shape of the theoretical curve of Bethe and Heitler, but the position of the maximum of the energy distribution curves in Sn, Ag and Cu shows a discrepancy with that to be expected theoretically. The theoretical difference between the average energies of the positrons and electrons in the elements studied, when plotted against Z, is consistently higher than the experimental, though both can be approximately represented by straight lines. The angular distribution of the positrons and electrons with respect to the incident γ-rays agrees with the theory. A.

539.166.74

6417. Radiative corrections to the Klein–Nishina formula. Schafroth, R. Letter in *Phys. Rev.*, **75**, 1111–12 (*April* 1, 1949).—The new covariant formalism of electrodynamics has been applied to the scattering of light by particles of spin $\frac{1}{2}\hbar$, and the corrected cross-section is given for the non-relativistic limiting case. The relativistic formula has been calculated. G. J. K.

539.166.74 : 535.43 : 535.33.07

6418. Inappreciable effect of Compton shifted scattering within a gamma-ray source, on precision wave-length determinations with the focusing crystal spectrometer. DuMond, J. W. M. Letter in *Phys. Rev.*, **75**, 1266 (*April* 15, 1949).—The line obtained with a monochromatic γ-radiation in the curved crystal spectrometer [Abstr. 345 (1948)] may be distorted by a continuous distribution on the long γ side, due to Compton scattering in the source material. Because of the narrow line width ($\Delta\lambda = 0{\cdot}17$ x.u.) only scattering into a narrow angle ($< 7°$) to the forward direction of the γ-radiation, need be considered. A calculation made on the basis of the Klein–Nishina formula shows that the max. height of the Compton scattered distribution is 4×10^{-3} times the line height in this instrument, and that the distortion in the line shape is negligible. L. R. S.

NUCLEAR REACTIONS 539.17

539.172

6419. Electro-disintegration of nuclei. Blair, J. S. Letter in *Phys. Rev.*, **75**, 907–8 (*March* 1, 1949).—Recent experiments [Abstr. 1645 (1948)] on the activity produced in stacks of uniform foils by electron bombardment give information on the ratio of the activity produced by electro-disintegration to that due to photo-disintegration by bremsstrahlung. A rough theoretical estimate of this ratio agrees with experiment. A more accurate calculation has been made using the cross-sections for electro-excitation obtained by Wick [Abstr. 1654 (1940)]. The ratio then depends on the kind of nuclear transition involved. Comparison with experiment suggests that electric dipole transitions do not predominate. H. McI

539.172

6420. Resonance effects in the reaction $H_1^3(d, n)He$. Allan, D. L. and Poole, M. J. Letter in *Nature Lond.*, **164**, 102–3 (*July* 16, 1949).—The excitation function of the reaction from 80–200 keV was observed in the bombardment of a thick, heavy ice target with H ions enriched to $1–2\times10^{-4}$ in H. The 90° yield was also compared with that of the $D(d, p)H^3$ reaction. A pronounced resonance was observed at 155 ± 15 keV, the value of the cross-section at resonance, 6 barns, being obtained by joining the curve to earlier low-energy data. [See Abstr. 3442 (1949)]. B.

539.172

6421. Neutron-hydrogen mass difference from the $T^3(p, n)He^3$ reaction threshold. Taschek, R. F., Jarvis, G. A., Argo, H. V. and Hemmendinger, A. Letter in *Phys. Rev.*, **75**, 1268–9 (*April* 15, 1949). The threshold was measured to be 1 019 keV $+\frac{1}{2}$ keV, -1 keV, by counting neutrons produced from a thick target of T absorbed in Zr, the voltage standard being the 993·3 keV Al (p, γ) resonance. This gives a Q of $-763{\cdot}7$ keV and n–H mass difference of $782 \pm 1{\cdot}5$ keV. B.

539.172

6422. Value of the Li (p, γ) resonance. Hudspeth, E. L. and Swann, C. P. Letter in *Phys. Rev.*, **75**, 1275 (*April* 15, 1949).—The energy of the F$(p,$ resonance has been given by other authors [Abstr. 2102 (1949)]. The value of this, $V_F = 875{\cdot}5$ ke is nearly double the value V_{Li} for the Li (p, γ) reaction which is known to occur at about 440 keV. The authors have determined the latter accurately, using the F(p, γ) resonance energy as a datum and measuring the difference $2V_{Li} - V_F$, between the accelerating voltage to obtain the Li resonance with the diatomic beam and that required for the resonance with the monatomic beam. After making a correction for the effect of target thickness a value of 11·2 keV was obtained for the voltage difference making $V_{Li} = 442{\cdot}4$ keV. L. R.

539.172

6423. The emission of short-range alpha particles from light elements under proton bombardment. I. Experimental method and the reaction $^{10}B(p\alpha)^7B$. Burcham, W. E. and Freeman, J. M. *Phil. Mag.*, **40**, 807–30 (*Aug.*, 1949).—The α-particles were resolved from the scattered protons by a 90° focusing magnet and detected by a fluorescent screen and photo-electric multiplier. The Q value of the reaction

$^{10}(p, \alpha)Be^{7}$ was found to be $1{\cdot}11 \pm 0{\cdot}06$ MeV, and the cross-section to be $1{\cdot}2 \times 10^{-26}$ cm² at a proton energy of 530 keV. A target of separated B^{10} isotope was used. L. S. G.

539.172.11

6424. The (α, n) cross section of boron. WALKER, R. L. *Phys. Rev.*, **76**, 244–7 (*July* 15, 1949).—The differential cross-section for the $B^{10, 11}(\alpha, n)N^{13, 14}$ reactions was measured as a function of the α-particle energy up to an energy of 5·3 MeV. To determine this cross-section, the number of neutrons emitted by B under α-particle bombardment was measured by comparison with a calibrated Ra-α-Be source in a graphite column. Resonances were observed at α-particle energies of 1·8, 2·5, 4·2, 4·9 MeV. A.

539.172.11

6425. The (α, n) cross sections of beryllium, magnesium, and aluminum. HALPERN, I. *Phys. Rev.*, **76**, 248–50 (*July* 15, 1949).—The (α, n) cross-sections were measured by counting the number of neutrons emitted from fairly thin targets of these elements for a given incident flux of α-particles. The energy of the α-particles was variable up to the full energy of 210 α-particles, 5·3 MeV. A.

539.172.3

6426. Yields of some photo-nuclear reactions. PERLMAN, M. L. Letter in *Phys. Rev.*, **75**, 988–9 (*March* 15, 1949).—Measurements were made on activities induced by 50 and 100 MeV X-rays in nuclei of $A \sim 60$. The results suggest that the rise of cross-section in this neighbourhood takes place over a range of up to 15 mass units, and not abruptly as reported earlier [Abstr. 3936 (1948)]. Evidence is also presented for a similar rise near $A = 130$. A. P. F.

539.172.3

6427. Angular distribution of protons from photodisintegration of the deuteron. LASSEN, N. O. Letter in *Phys. Rev.*, **75**, 1099 (*April* 1, 1949).—Corrects results given in a previous letter [Abstr. 2104 (1949)], the new values being $\sigma_0 = (0{\cdot}15 + 0{\cdot}85 \sin^2\theta)\sigma_{90}$; $\sigma_0/\sigma_{90} = 0{\cdot}15 \pm 0{\cdot}03$ and $\sigma_m/\sigma_e = 0{\cdot}26$. B. R.

539.172.3

6428. "Cross-over transitions" in Cl^{38}, Co^{60}, Br^{82} and Sb^{124}. MYERS, V. AND WATTENBERG, A. Letter in *Phys. Rev.*, **75**, 992–3 (*April* 15, 1949).—Using the methods previously described [Abstr. 1625 (1947)], the intensities and energies of weak γ-rays were measured by $D(\gamma, n)$ and $Be(\gamma, n)$ reactions. Using ~ 10 curie sources, Br^{82} and Sb^{124} gave definite evidence of crossover transitions, Cl^{38} results were masked by bremsstrahlung and Co^{60} gave no neutrons. The theoretical implications are discussed. B. R.

539.172.3

6429. Erratum: Disintegration of Be^{8}. HEMMENDINGER, A. Letter in *Phys. Rev.*, **75**, 1267 (*April* 15, 1949).—The value of 116 keV [Abstr. 2578 (1948)] for the disintegration energy is wrong, as the impulse given to the Be^{9} nucleus in capturing the MsTh γ-ray was neglected. The corrected result is 103 ± 10 keV. A. P. F.

539.172.3

6430. Theory of the photo- and electrodisintegration of Be^{9}. GUTH, E. AND MULLIN, C. J. *Phys. Rev.*, **76**, 234–44 (*July* 15, 1949).—Cross-sections for the photo- and electrodisintegration processes at relatively low energies have been calculated as a function of energy on the basis of a simple model of the Be^{9} nucleus in which a neutron is assumed to move in the potential well provided by the remainder of the nucleus. According to the theory, the disintegration at low energies results primarily from electric dipole transitions from the ground $P_{3/2}$ state to S and D states in the positive energy continuum. Magnetic dipole disintegration does not seem to play an important role. In order to obtain agreement between the theoretical and empirical photo-disintegration cross-sections, it seems necessary to make the plausible assumption that the interaction between the prospective photo-neutron and the remaining nucleons of the nucleus is a function of the orbital angular momentum of the system (Majorana interaction). Furthermore, complete neglect of the $P_{3/2} - P_{\frac{1}{2}}$ splitting of the lowest P state leads to an angular distribution of the ejected neutrons which does not agree with the (preliminary) empirical results. Using the Born–Moller approximation, the cross-section for electrodisintegration has been calculated in terms of the photodisintegration cross-section. This method yields a correlation, which is independent of the nuclear model, between the observed photo- and electrodisintegration cross-sections. The theory based upon the simple model described seems adequate for an interpretation of the experimental data. A.

539.172.3

6431. Angular distribution of photo-neutrons from deuterium. MEINERS, E. P., JR. *Phys. Rev.*, **76**, 259–63 (*July* 15, 1949).—A study has been made, using 2·76 MeV Na^{24} γ-rays, of the angular distribution of photo-neutrons from D under approximately ideal conditions of low neutron scattering from the general surroundings into the detector. Results were obtained for two general methods of neutron detection, a BF_3 chamber and the Szilard–Chalmers reaction on $Ca(MnO_4)_2$. Assuming the neutron distribution to have, in the barycentric system, the form $I(\theta) = a + b \sin^2\theta$, the values of a/b obtained are $0{\cdot}212 \pm 0{\cdot}008$ for the first method and $0{\cdot}203 \pm 0{\cdot}040$ for the second, giving as a weighted average $0{\cdot}211 \pm 0{\cdot}008$. From this, the ratio of the photomagnetic cross-section to the photoelectric cross-section is calculated to be $0{\cdot}317 \pm 0{\cdot}012$. A.

539.172.4

6432. Difference in the recoil energy of the Br^{80} isomers following neutron capture. CAPRON, P. P., CRÈVECOEUR, E. AND FAES, M. Letter in *J. Chem. Phys.*, **17**, 349–50 (*March*, 1949).—A study of the relative amounts of the isomers collected on to Au electrodes in C_6H_5Br after neutron irradiation showed that the 18 min isomer was not collected as efficiently as the 4·5 hr body. This suggests that a larger recoil is given to the γ-radiating nucleus in descending to the metastable state than to the ground state, thereby encouraging liberation of Br ion in the former case. A. P. F.

539.172.4

6433. Fission fragment energies in U^{235} and U^{239}. BRUNTON, D. C. AND HANNA, G. C. Letter in *Phys.*

Rev., **75**, 990–1 (*April* 15, 1949).—The source, a 14 μgm/cm^2 collodion film containing 3–5 μgm/cm^2 of U, was mounted on the common cathode of a double back-to-back ion chamber and exposed to neutrons from the thermal column of the Chalk River pile. Fragments in a 5 MeV energy interval were selected by an electronic gate in one side of the chamber. The energy spectrum of fragments in the other side of the chamber, in coincidence with those in the selected interval, was determined by means of a 30-channel pulse analyser. It was found that if the selected interval lay in the heavy fragment group the spectrum of the coincident light group fragments was almost independent of the position of this interval and vice versa. Contour diagrams are given for the modes of fission in U^{233} and U^{235}. Max. total kinetic energy of the two fission fragments is found to occur, when their mass ratio is 1·25. Tables are given, comparing results for U^{233}, U^{235} and Pu^{239}, and comparing the authors' data for U^{235} with those of earlier authors. L. R. S.

539.172.4

6434. Search for short-lived Y, Zr and Cb fission products. KATCOFF, S. AND BROWN, L. J. Letter in *J. Chem. Phys.*, **17**, 505 (*May*, 1949).—Results of the application of recoil methods to the separation of fission products from Y, Zr and Cb are described and compared with those of chemical methods. New short-lived products are reported. C. B. A.

539.172.4

6435. Neutron cross sections at 115 ev and 300 ev. I. HIBDON, C. T. AND MUEHLHAUSE, C. O. *Phys. Rev.*, **76**, 100–3 (*July* 1, 1949).—Total neutron cross-sections for a number of elements were measured at 115 eV and 300 eV with an energy resolution of approx. 10%. The cross-sections were separated into two parts: a resonance cross-section and an asymptotic cross-section. The first cross-section represented the effect of a neutron resonance in the material studied overlapping the detector. The second cross-section was identified either as the potential scattering cross-section, or a minimum cross-section in the neighbourhood of a resonance. A.

539.172.4

6436. Total cross section measurements for fast neutrons. BOCKELMAN, C. K., PETERSON, R. E., ADAIR, R. K. AND BARSCHALL, H. H. *Phys. Rev.*, **76**, 277–9 (*July* 15, 1949).—The total cross-sections of Zr, Ag, In, Sb, I, Ta and Pb have been measured as a function of neutron energy in the energy range from 20 keV to 1 600 keV. A spread in energy of 30 keV was used up to 200 keV, and a spread of 70 keV above this energy. Indications of structure were found in Zr and Pb. The results are compared with the predictions of the statistical theory. A.

539.172.4 : 539.163.1–2

6437. The chain $_{56}Ba^{130}$ (n,γ) $_{56}Ba^{131} \rightarrow {}_{55}Cs^{131} \rightarrow {}_{54}Xe^{131}$. YAFFE, L., KIRSCH, M., STANDIL, S. AND GRUNLUND, J. M. Letter in *Phys. Rev.*, **75**, 699–700 (*Feb.* 15, 1949).—Al absorption measurements on the radiations from Cs separated from neutron-irradiated Ba showed a β-radiation (int. conv. electrons of a 145 keV γ-ray of Cs^{131}) of 115 keV and an X-ray of 31 keV. The $\frac{1}{2}$-life is 9·6 ± 0·1 d. Assuming the Cs^{131} γ-ray is 97% converted, the cross-section for Ba^{130} for neutron capture is 24 ± 8 millibarns. A. O.

539.172.4 : 541.1

6438. Radiocolloidal behaviour of some fissio products. SCHUBERT, J. AND CONN, E. E. *Nucleonic* **4**, 2–11 (*June*, 1949).—The formation of radic colloids when concentrations were far too low t exceed the solubility products was studied by dialysi ultrafiltration and diffusion measurements. Redu tions in the fraction of radioelement existing i colloidal form could be produced by formation c complexes or by increase of acidity. Values of th diffusion coefficients for Zr^{95} and Cb^{95} in uran nitrate suggested a colloidal particle radius of 8–10 Å The adsorption of colloidal tracer elements on syn thetic resin cation exchangers was found to increas with an increase of uranyl ion concentration, instea of decreasing as it should by mass action principle this could in fact be used to separate radiocolloi from normal cations. Various types of experimen are quoted in which care must be taken to avoi spurious results through colloid formation. A. P. I

539.173.

6439. Neutron yield from $Li^7(p,n)Be^7$. FREIER, G LAMPI, E. E. AND WILLIAMS, J. H. Letter in *Phys. Rev.*, **75**, 901–2 (*March* 1, 1949).—The neutron yiel was measured for p-energies from 1·88 to 3·66 Me to detect the resonance at 3·06 MeV reported b Hill and Shoupp [Abstr. 2565 (1948)], but wit negative results. The results obtained confirm Taschek and Hemmendinger [Abstr. 3927 (1948)]. R. B. S

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.1

6440. The penetration of μ-meson decay electron and their bremsstrahlung radiation. HINCKS, E. H AND PONTECORVO, B. Letter in *Phys. Rev.*, **75** 698–9 (*Feb.* 15, 1949).—Absorption experiments i Pb, Al and C, of the decay products of μ-meson show the existence of a "hard component" which i identified with bremsstrahlung from the charge decay particles. It is concluded that the brems strahlung intensity is inconsistent with decay particle of $>$ electronic mass, that the average energy d decay particles is > 25 MeV and that the presenc of bremsstrahlung makes absorption methods un suitable for the determination of an upper limit o decay electron energy. J. G. W

539.1

6441. On mesons π and μ. MARSHAK, R. E Letter in *Phys. Rev.*, **75**, 700–1 (*Feb.* 15, 1949). The present status of the two-meson hypothesis i reviewed. The capture behaviour of negative and μ mesons is explicable if π mesons are of integra spin and if negative μ capture follows the scheme $\mu + P \rightarrow \pi + Q + P \rightarrow N + Q$, where Q is th neutral product of π decay (= neutrino). It follow that the μ meson is of $\frac{1}{2}$-integral spin, and this i consistent with a continuous electron spectrum a

cay. It is not clear that a correct field theory of clear force can be constructed with only one ongly coupled meson. J. G. W.

539.18

42. Cerenkov radiation effect in meson theory. ADA, W. W. Letter in *Phys. Rev.*, **75**, 981–2 *pril* 15, 1949).—Mesonic Cerenkov radiation is pected to occur if the source of the field has a locity greater than the phase velocity of the meson ld. A phenomenological treatment is suggested ing a Klein–Gordon equation with 2 nuclear efractive indices." A solution has been obtained, ing the method of Cox [Abstr. 619 (1945)]. G. J. K.

539.18

43. On the stimulated decay of mesons. FURRY, . H. AND SNYDER, J. N. Letter in *Phys. Rev.*, **75**, 65–6 (*April* 15, 1949).—If a meson were to interact mmetrically with both heavy and light particles, e decay of the meson to electron and neutrino ight be stimulated by interaction with the nucleons ose collision produced it. The change of lifetime a scalar meson arising from this process is shown be negligibly small. J. G. W.

539.18

44. Cloud-chamber study of mesons stopping in uminium foils. COOL, R. L., FOWLER, E. C., REET, J. C., FOWLER, W. B. AND SARD, R. D. tter in *Phys. Rev.*, **75**, 1275–6 (*April* 15, 1949).— 12 100 photographs, 10 cases have been obtained mesons stopping in Al foils placed across a cloud-amber. 4 out of the 10 photographs showed acks of further particles originating from the opping point, 3 light and 1 heavy. E. G.

539.18

45. Capture of negative mesons. HUBY, R. *hil. Mag.*, **40**, 685–98 (*July*, 1949).—The time taken r a meson, stopping in a solid, to reach its lowest ohr orbit about a nucleus, is discussed. The possi-lity of "trapping" for a long time in a bound orbit insulators is studied. The time spent in a trap is lculated approximately and the results are consistent ith experimental observations on π and μ mesons. or heavy mesons the time of approach to a nucleus normally 10^{-13} to 10^{-12} sec, but trapping may be pected to occur for times up to 10^{-5} sec. L. S. G.

539.18 : 530.145

Interaction of mesons with nucleons and light articles. *See Abstr.* 5950

539.18 : 539.166

446. Radiation accompanying meson creation. CHIFF, L. I. *Phys. Rev.*, **76**, 89–93 (*July* 1, 1949).—lectromagnetic radiation is expected to accompany ie creation of charged mesons in nucleon-nucleon ollisions. The amount and character of this radia-on is calculated for mesons of spin 0, $\frac{1}{2}\hbar$, and $\hbar$, in ach case with normal magnetic moment. The ratio f radiated energy to initial meson energy increases garithmically for high meson energy in the first two ases, and is $\sim 1\%$ for the highest energies of interest cosmic radiation. For vector (spin $\hbar$) mesons, is ratio is $(11\alpha/4\,860\,\pi)(E/mc^2)^4$ in the relativistic gion, where α is the fine-structure constant, and and E are the rest mass and the initial energy of the meson in the co-ordinate system in which the centre of mass of the colliding nucleons is at rest. This is so large at high energies that the assumption that π-mesons have spin $\hbar$ would, with a plausible theory of the multiplicity of meson production, account for the observation of soft radiation in conjunction with energetic nuclear events. A.

539.18 : 539.17

6447. Threshold energy for meson production. BARKAS, W. H. Letter in *Phys. Rev.*, **75**, 1109–10 (*April* 1, 1949).—Absolute threshold energies are calculated by elementary considerations for many types of incident beam and target. Observable thresholds may be higher but not lower. Various reasons are considered, why the theory of Macmillan and Teller [Abstr. 2649 (1947)] erroneously gives lower values in some cases. G. J. K.

539.185

6448. The scattering of slow neutrons by paramagnetic crystals. RUDERMAN, I. W., HAVENS, W. W., JR., TAYLOR, T. I. AND RAINWATER, L. J. Letter in *Phys. Rev.*, **75**, 895–6 (*March* 1, 1949).—The total cross-section of MnF_2 was measured for neutron energies 0·002–10 eV (0·1–6 Å) using a velocity spectrometer [Abstr. 1317 (1947)]. After subtraction of nuclear scattering, the residue was shown to agree well with that predicted theoretically [Abstr. 3008 (1939)] for elastic scattering due to interaction of the neutron moment with isolated paramagnetic ions. A. P. F.

539.185

6449. The effect of small angle scattering on neutron cross-section measurements. KRUEGER, H. H. A., MENEGHETTI, D., RINGO, G. R. AND WINSBERG, L. Letter in *Phys. Rev.*, **75**, 1098–9 (*April* 1, 1949).—Transmission experiments were performed using velocity-selected thermal neutrons. The detector was a BF_3 counter with a sensitive area defined by a rectangular slit. For powdered and porous samples, the apparent cross-section became considerably smaller as the angle subtended by the counter at the sample was increased. This suggested small-angle scattering, and the variation of the effect with sample thickness indicated that the scattering was chiefly multiple. By moving the slit detector over the cross-section of the beam, the broadening due to this scattering was directly observed. A. P. F.

539.185

6450. Inelastic scattering of 14·5-MeV neutrons by lead. GITTINGS, H. T., BARSCHALL, H. H. AND EVERHART, G. G. Letter in *Phys. Rev.*, **75**, 1610–11 (*May* 15, 1949).—Threshold detectors in the form of foils of Al or Cu were placed at the centre of a Pb sphere that was bombarded with neutrons from a $T + D$ source. Activities due to the Al(n,p) reaction (threshold ~ 3 MeV) and to the Cu$(n,2n)$ reaction (threshold ~ 11 MeV) were measured. The cross-section for absorption and inelastic scattering to below the detector threshold was found to be $\sim 2{\cdot}2$–$2{\cdot}3$ barns in both cases, implying that 14·5 MeV neutrons lose more than 11 MeV in their first collision in Pb. A. P. F.

539.185

6451. On the decrease in neutron density at a boundary. RAETHER, H. *Z. Phys.*, **125** (*Nos* 4–6) 269–73 (1948) *In German.*—Measurements were made of the variation of thermal neutron density with distance from the boundary between a Cd layer (simulating vacuum) and D_2O or H_2O in a container with dimensions of several mean free paths. For both D and H the density appeared to fall less rapidly towards the boundary than would be expected theoretically. For D the effect was rather pronounced, and could be explained in terms of anisotropy of scattering, with $\overline{\cos\theta} \sim 0{\cdot}3$. A. P. F.

539.185 : 530.145

Theory of the effective range in nuclear scattering. *See Abstr.* 5944

539.185 : 530.145

Scattering of high energy neutrons by protons with non-central interaction. *See Abstr.* 5957

STRUCTURE OF SOLIDS 539.2

539.211

6452. The study of the surface structure of metals by X-rays. LEGRAND, C. *Rev. Metall.*, **46**, 147–50 (*March*, 1949) *In French.*—A short account of some of the results of Abstr. 3966 (1948). A. E. DE B.

539.213 : 535.8

The mechanism of optical polishing. *See Abstr.* 6143

539.215.4

6453. Method of obtaining an exact granulometric curve by use of Stokes' formula and micrometric measurements. VANDERSTEPPEN, R. *Bull. Acad. Roy. Belge Cl. Sci.*, **35**, 60–9 (*Jan.*, 1949) *In French.*—Stokes's theory only applies to spherical particles, and sedimentation tests therefore only give the general trend of the curve unless supplemented by other data. The distribution of particles up to 5 μ in diameter is found by counting particles visible in the eye-piece of a microscope; over 5 μ the distribution is found by weighing. Details are given of the statistical treatment required to give the true distribution. N. C.

539.23

6454. An electron diffraction study of anodic films formed on aluminium. YOSIDA, S. *J. Phys. Soc. Japan*, **3**, 175–6 (*March–June*, 1948) *In English.*—A short note on the crystal structure of anodic films formed on Al. Transmission and reflection patterns obtained from films formed on Al anodized in 3% oxalic acid showed broad haloes which changed into the (*hk*0) rings of γ–Al_2O_3 on heating. It is concluded that the films consisted of finely divided oriented crystal grains of γ–Al_2O_3. Films formed in 3% sulphuric acid gave sharp ring patterns corresponding to hydrated γ–Al_2O_3 and some Al hydroxides. On heating, the films gave patterns of γ–Al_2O_3. M. R. H.

539.23

6455. High temperature furnace for electron diffraction studies of thin films. ALESSANDRINI, E. I. *J. Appl. Phys.*, **20**, 691–3 (*July*, 1949).—A furnace has been designed which enables one to carry out electron diffraction studies of thin films at high temperatures. Electron diffraction patterns are obtainable up to 1 100°C. It is possible to bring the furnace up to 1 500°C, but at temps. over 1 100°C the photographic plates are fogged by light emitted from the furnace. With the use of this furnace, recrystallizations and phase changes in thin metal and alloy films can be studied at the temps. where these phenomena occur.

539.25 : 6

6456. Examination of metals by optical metho CONN, G. K. T. AND LEAK, G. M. *Nature, Lon* **164**, 37–8 (*July* 2, 1949).—A brief account of a co ference arranged by the British Iron and Steel Resea Association, on the application of phase-contr microscopy, the reflecting microscope and multip beam interferometry to metallurgical problems. M. R.

539.2

6457. High temperature X-ray diffraction techniqu LANDER, J. J. *Rev. Sci. Instrum.*, **20**, 82–3 (*Jan.*, 194 —Describes three types of accessories for X-r studies of powders at high temp. in vacuum or co trolled atmosphere. Temps. up to 1 400°C may reached. A. E. DE

539.2

6458. Preliminary results of a further X-ray inves gation of Cu–Fe–Ni alloys. HARGREAVES, M. *Acta Cryst.*, **2**, 259 (*Aug.*, 1949) *In English.*—T technique of Bradley [Abstr. 619 (1940)] and Dan and Lipson [Abstr. 2628 (1943); 2322 (1944); 13 (1948)] is improved by the use of a focusing mon chromator passing Fe$K\alpha_1$ radiation only. T interpretation of the "side bands" is discussed. A. J. C.

539.264 : 548.73

X-ray diffraction studies of solid solutions. *Abstr.* 6572

539.

6459. Spherical particles for electron microsco SCOTT, G. D. *J. Appl. Phys.*, **20**, 417–18 (*April*, 194 —A certain polystyrene latex is an aqueous suspensi of very uniform spherical particles. Electro microscopic measurements show that uniformity a given mount is within error of measurement (1 for all but 1 in 10^4 particles, but size is apparen in part determined by mounting procedure, differe mounts exhibiting sizes between 2 500 and 3 000 Å The great majority of particles appears accurate spherical. J. C. B

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31 : 541.

Elasticity of vulcanised rubber. *See Abstr.* 6524

539.313 : 548

6460. The internal friction of zinc single crysta WERT, C. A. *J. Appl. Phys.*, **20**, 29–37 (*Jan.*, 1949). Presents typical data on the internal friction,

rmined by the decrement, of 12 single crystals Zn, oscillating longitudinally. The measurements e made at 41 and 57 kc/s. The effects of purity the Zn, stress amplitude, up to 3× the static tic limit in one case, temp. and prior application static stress were investigated. The results are n in a series of curves in which decrement is ted against max. stress amplitude. The possiy of the origin of internal friction being in surface cts and lattice imperfections is discussed. The eme sensitivity of the decrement to these factors oted. G. O. B.

539.32.082 : 534.17

1. A method of measuring dynamic mechanical perties of rubber-like materials. HILLIER, K. W., SKY, H. AND LEWIS, J. P. Letter in *J. Appl. S.*, **20**, 226–7 (*Feb.*, 1949).—More exact formulae, wing for reflection at the pick-up, are given for method of measuring the dynamic elastic proies of rubber described by Nolle [Abstr. 721 ·9)]. T. S. E. T.

539.373

2. Slip in metals. BRAGG, L. *Physica*, **15**, 91 (*April*, 1949) *In English.*—See Abstr. 3358 ·7).

539.374

3. On the general equations of problems of l symmetry in the theory of plasticity. SYMONDS, *Quart. Appl. Math.*, **6**, 448–52 (*Jan.*, 1949). — general equations for axial symmetrical problems derived from the Mises flow condition and the it Venant–Levy–Mises stress-strain relations. se, with the equations of equilibrium, are investid and, in general, form a system of elliptic type. ce no real characteristic curves exist, except er special conditions when the problem reduces ne of plane strain. J. E. C.

539.374

4. Experimental verification of the fundamental of plastic theory. KISHKIN, S. T. AND RATNER, *J. Tech. Phys., USSR*, **19**, 412–20 (*March*, 9) *In Russian.*—The Saint Venant and Huber– es theories were found not to be of general ication and to be correct only in individual, ial cases. The yield limit (under tangential ses) cannot be regarded as a constant of the erial and as independent of the method of loading. relation between the true yield limits in tensile sing and torsion depends on the structure of the erial, i.e. on its lattice, the degree of metastability homogeneity. The characteristic to be used for ulations should be the conditional yield limit rmined from the formulae for elastic torsion, being higher by 20–30% than the true yield limit orsion. In calculating for torsion, the experitally determined values of the conditional yield s must be used instead of the old theoretical ficients 0·5 and 0·6. B. F. K.

539.374

5. Investigation of the deformed state by means rolled-on graduated network. ZILOVA, T. K. AND MAN, Y. B. *J. Tech. Phys., USSR*, **19**, 431–40 *rch*, 1949) *In Russian.*—A clear differentiation is important between the local (or maximum) plasticity, and the average plasticity of a specimen or machine part. These two characteristics coincide only in the special case of the uniformly deformed state. The laws of plastic deformation should be studied above all on the local plasticity in the uniformly deformed state or on small deformed volumes, with consideration of the whole field of deformations. In practice it is often necessary to consider the general or total plasticity, depending not only on the local maxima of plasticity, but also on the gradient of the plastic deformation. The new method presented enables a simple investigation of the local plastic deformations to be carried through. It is simpler and not less accurate than the method of the photo-network. It is shown in its application to smooth and notched Al and steel specimens. It is shown that the maximum displacement in the depth of a sharp notch in Al is equal to the maximum displacement for a smooth specimen. Thus the influence of the notch in this case leads only to a reduction in the average, and not in the maximum plasticity. It is further shown that for hardened and tempered steels the maximum displacement in the depth of the notch is considerably smaller than for a smooth specimen. A characteristic of the relative gradient of plastic deformation, i.e. $\Gamma = g_{max}^{-1}\partial g_{max}/\partial l$ is presented. B. F. K.

539.374

6466. The stress dependence of the viscosity of bitumens. SACK, R. A. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T197*) 7 *pp.* (1948).—The previous theory of flow applicable to bitumens of the sol type is extended to calculations of the variation of the effective viscosity under tensile and compressive stresses. It is found that for steady flow the viscosity should increase under tension and decrease under compression. As in practice the viscosity decreases with applied stresses irrespective of sign, a number of suggestions are made to account for the discrepancy. Experiments are suggested to determine any difference between the effective viscosities for equal tensile and compressive stresses; the magnitude of this difference would indicate to what extent the elastic properties of bitumens are due to their solid and fluid components respectively. A.

539.374

6467. Coefficient of anomalous viscosity. MACK, C. Letter in *J. Appl. Phys.*, **20**, 225 (*Feb.*, 1949).—The equation for this coefficient [see Abstr. 1205 (1949)] is modified using Batschinsky's [*Zeit. f. Physik. Chemie.*, **84**, 643 (1913)] relation between the viscosity and the specific volume and those for strain-, stress- and time-hardening and thixotropy change correspondingly. Prandtl's equation relating shear stress and shear strain is derived from the von Mises–Hencky condition $WG =$ constant, where W is the energy of change of shape and G is the rigidity modulus. J. E. C.

539.377

6468. The formation of recrystallization nuclei. BECK, P. A. Letter in *J. Appl. Phys.*, **20**, 633–4 (*June*, 1949).—According to van Arkel [Abstr. 4140 (1930)], the high stress points in a deformed metal are potential locations of nuclei, which become active

after transformation into relatively stress-free lattice portions. It is now suggested that polygonization is the mechanism by which the transformation takes place. The increasing rate of nucleation on annealing can be explained on the assumption that the length of annealing time required for polygonization at any point is determined by the stress level at that point, the number of lattice regions with decreasing stress energy being progressively larger. J. A. F.

539.382

6469. A mathematical formulation of the general continuous deformation problem. GLEYZAL, A. *Quart. Appl. Math.*, **6**, 429–37 (*Jan.*, 1949).—Stress-strain relations for finite strain of a continuous medium are formulated in tensor notation referred to an embedded co-ordinate system x^i ($i = 1, 2, 3$). Any varying deformation is described by the displacement functions $\bar{x}^\alpha = \bar{x}^\alpha(x^i, t)$ ($\alpha = 1, 2, 3$), giving the position $\bar{x}^\alpha$ in space of the particle x^i at time t. The length ds of an element dx^i is given by $ds^2 = g_{ij}dx^i dx^j$, where the "deformation tensor" g_{ij} is a function of x^i and t. Any stress-strain relation can be expressed in the form $\sigma_{ij} = \phi_{ij}[g_{ij}(x^i, t), x^i, t]$, where σ_{ij} is the stress-tensor referred to the embedded co-ordinates x^i, and ϕ_{ij} is a functional of g_{ij} besides varying also with x^i and t. Equilibrium conditions are formulated in terms of the co-ordinates x^i, and procedures required in specific problems are illustrated by two simple examples. Generalized definitions of Young's modulus and Poisson's ratio for finite strain are derived. A. T. P.

539.382

6470. Complementary minimum principles for an elastic-plastic material. GREENBERG, H. J. *Quart. Appl. Math.*, **7**, 85–95 (*April*, 1949).—The mechanical behaviour of a body of isotropic material obeying the stress-strain law of Prandtl and Reuss is investigated. Two minimum principles relating to the mixed boundary value problem where the velocities are given on part of the surface and the rates of change of the surface stresses on the rest are derived. These play an analogous part to that of the principles of Castigliano and of minimum potential energy in the theory of elasticity. L. S. G.

539.383

6471. Hertz's problem and Brinell test. ZAITSEV, G. P. *J. Tech. Phys., USSR*, **19**, 336–46 (*March*, 1949) *In Russian.*—The elastic and plastic parameters of metals as functions of the properties of atoms and the crystal lattices consisting of them, are closely interconnected. The elastic limit is a well-determined function of the two elastic parameters E and μ and of two specific plastic parameters of the ball indentation test, a_0 and n. Owing to the interrelation of the elastic and plastic parameters, Hertz's and the author's form formulae, both of which are based on the plastic laws of the impression process of a small ball into the metal, give identical results in the calculation of the diameter of the "limiting" imprint d_z, representing the upper limit of the elastic, and lower limit of the plastic imprint. Brinell hardness depends on the ball diameter, the dia. of the imprint, the 2 elastic parameters E and μ and the 2 plastic parameters σ_E and n, where n is the exponent Meyer's formula. The 4 parameters mentioned a determine the coefficient of the "limiting" ball lo (P_z/D^2) corresponding to the occurrence of the f plastic deformation. B. F.

539.38

6472. Some factors affecting the rate of precipi tion hardening in Cu–Be alloys. BECK, P. A. *J. A Phys.*, **20**, 666–8 (*July*, 1949).

53

6473. Quantitative predictions from dislocat models of crystal grain boundaries. SHOCKLEY, AND READ, W. T. Letter in *Phys. Rev.*, **75**, 692 (*F* 15, 1949).—Illustrates how theoretical and exp mental investigations of grain boundaries r furnish direct proof of the presence of particu arrays of dislocations in solids. H. P

53

6474. The use of a trellis model in the mechanics homogeneous materials. WEISSENBERG, K. *J. T Inst., Manchr.*, **40**, *T*89–110 (*Feb.*, 1949). **Homog eous strain and the trellis model.** SHORTER, S. *Ibid.*, *P*228–40 (*March*, 1949).—The theory of a tre model, developed from the classical theory of st and strain, to obtain a solution of the problem imposing a homogeneous state of stress and strain a flat sheet of material is given in detail. The mo is of considerable use in testing materials such fabrics; the character of an imposed strain may deduced from a study of the shape assumed patterns, marked on the material, under the actio tensile forces. Since the trellis model can be c structed from Meccano parts, the performance materials in sheet form under various imposed fo and boundary conditions can be deduced with calculation. The model also leads to the develop of new types of stretching devices for imposing homogeneous states of strain and/or stress which desirable in the testing of fabrics and other mate in sheet form. H. J. I

539.4

6475. Generalization of the statistical theory strength on the case of the non-uniformly stre state. KONTOROVA, T. A. AND TIMOSHENKO, O. *J. Tech. Phys., USSR*, **19**, 355–70 (*March*, 1949) *Russian.*—The authors present their theory merel one of many possible variants of the statist description of the role of various defects existin real materials, without claiming more for it than represent one of the most evident methods, as based on Gaussian distribution functions. Owin the lack of experimental data on the influence of scale factor on the brittle strength of non-unifor stressed materials, an immediate verification of theory was not possible; certain relations, howe referring to the uniformly-stressed state, are in fa good agreement with experimental results, and applies also to certain qualitative deductions of given theory of brittle strength in bending and tors It may thus be expected that the method may pr valuable in its application to studies of the influe of the scale factor on the mechanical characteristic solids. B. I

539.4.01

6476. New results concerning the influence of liquid the resistance to rupture and the dimensions of a id body. BENEDICKS, C. *Rev. Métall.*, **46**, 291–3 *ay*, 1949) *In French.*—Absorption of liquid by a id has been found to affect the mechanical strength d volume of the solid. Absorption of water caused 3% reduction of the strength of glass, and a 22% uction of that of tempered steel, but absorption of rol by the steel caused an increase of strength of %. To a limited extent, but with a few notable eptions, the strength of sugar cubes diminished in portion to the surface tension of the liquid orbed. A quartz fibre increased in length during nersion in water, and, when dried, returned to its ial length. Approximately ½ hr was needed for fibre to attain max. length, but a fibre which had n wetted and dried before the start of the test ined max. length immediately after immersion.

A. C. W.

539.42 : 666

7. The interpretation of the experimental data on strength of glass. JONES, G. O. *J. Soc. Glass h.*, **33**, 120–37 (*April*, 1949).—The main conclusions experimental work on the strength of glass are ussed from the point of view of the Griffith flaw ory and of later theories of the strength of solids. attempt is made to present a broadly correct rpretation of the phenomena and to suggest why er explanations of particular phenomena may be orrect. The possible origins of the flaws are ussed and suggestions made as to the most useful ections for further experimentation. A.

539.42

8. The effect of the surrounding atmosphere on delayed fracture of glass. GURNEY, C. AND RSON, S. *Proc. Phys. Soc., Lond. B*, **62**, 469–76 *g.*, 1949).—Round soda-lime-silica glass rods e subjected to a series of given bending moments, l times to fracture were recorded. Experiments e made in air and *in vacuo* of 10^{-1} and 10^{-5} mm Hg; and the effects of heating *in vacuo* to drive absorbed atmospheric constituents were also in- igated. For the same prior heat treatment the es of the curves of stress against time to fracture rease with decrease of pressure. At 10^{-5} mm Hg, r heat treatment, the curve was very flat. It is lent that the main cause of delayed fracture is k of the glass by atmospheric constituents. eriments in which glass was subjected to air from ch water vapour and CO_2 were removed separately together showed that both these substances se delayed fracture. Other constituents of the osphere seem relatively ineffective. These con- ions are in agreement with the work of Preston his collaborators. It is further concluded that the ospheric constituents can be supplied by capillary id contained in surface cracks and by migration n surface layers as well as by direct attack from gaseous phase. A.

539.434

9. The effect of instantaneous pre-strain on the acter of creep in lead polycrystals. KENNEDY, *Proc. Phys. Soc., Lond. B*, **62**, 501–8 (*Aug.*, 1949).—The extension-against-time curves of Pb wires that have been subjected to rapid strain just before the experiment may be expressed by the Andrade creep equation $l = l_0(1 + \beta t^{\frac{1}{3}}) \exp(\kappa t)$, using the same constants as those which satisfy the creep of the metal under the same constant stress, but with the t value associated with β replaced by $(t + t_0)$, where t_0 is a constant for a given experiment, its value increasing with increasing pre-strain. While for pre-strains less than 10% the value of κ is unchanged by the pre-strain, for greater pre-strains the κ-flow is also modified and appears to approach more nearly to a linear variation with stress. A.

539.5

6480. The mechanism of dilatancy. ANDRADE, E. N. DA C. AND FOX, J. W. *Proc. Phys. Soc., Lond. B*, **62**, 483–500 (*Aug.*, 1949).—The dilatancy in question is the change of overall volume produced by strain in an assembly of particles. This has been demonstrated in the case of a mixture of sand and water by a photoelectric method of measuring the wetness of the surface. The general phenomenon has been experimentally studied in detail with a two-dimensional hexagonal array of uniform cylinders, part of the free surface of which is loaded with a rigid piston. An alternate increase and decrease of overall volume as the piston descends has been demonstrated and the mechanism of slip by which it comes about has been established. The elastic stress distribution in the array before slipping takes place has been calculated and shown to be a determining factor. The effect of friction between the component units has been studied. Experiments have also been carried out on three-dimensional irregular arrays of carbon shot and of sand. A.

539.501 : 532.516

The fundamental rheological equation for a Maxwellian chart. *See Abstr.* 5986

539.501 : 541.64

6481. Intrinsic viscosity of linear polymers. WILSON, J. N. Letter in *J. Chem. Phys.*, **17**, 217 (*Feb.*, 1949).—An interpolation formula $[\eta] = K_1 Z/(1 + K_2 Z^{\frac{1}{2}})$ is discussed. Z is the number of links in the polymer chain and expressions for K_1 and K_2 are given. The utility and scope of the formula is discussed. W. R. A.

539.53

6482. Hardening and internal stress. VITOVEC, F. *Öst. Ingen. Arch.*, **3** (*No.* 2) 119–28 (1949) *In German.*—Mainly a review. If ε is the strain and σ the stress, the fraction of the cross-section of a stretched specimen which is still elastically extended is given, under certain assumptions, by E'/E, where E' is $\partial\sigma/\partial\varepsilon$ above the yield point and E is $\partial\sigma/\partial\varepsilon$ below. A. J. C. W.

539.89 : 523.51

Widmannstätten structure in meteoric iron. *See Abstr.* 5889

539.89 : 539.32

6483. Variation of the mechanical characteristics of metals under hydrostatic pressure. RATNER, S. I. *J. Tech. Phys. USSR*, **19**, 408–11 (*March*, 1949) *In Russian.*—It was experimentally established that the normal stress in the slip plane is of considerable influence on the whole process of the plastic flow.

Under hydrostatic pressure not only the rupturing strength and the plastic limit, but also the resistance to plastic deformation are altered. The effect of the hydrostatic pressure on the characteristics of t metal depends above all on the structure of t latter. B. F.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM 541.121/.123

541.123.2 : 541.183

6484. Thermodynamic transition from adsorption into solution. HILL, T. L. Letter in *J. Chem. Phys.*, **17**, 507 (*May*, 1949).—A preliminary theoretical discussion of systems consisting of a perfect gas A in equilibrium with a condensed phase containing A and B. In particular, the author deals with cases where at low pressures a gas is adsorbed on a solid, while at high pressures solution takes place; he gives a single thermodynamic treatment covering the transition [see Hill, T. L., *J. Chem. Phys.*, **17**, 503 (1949)]. J. I.

REACTION KINETICS 541.124/.128

541.124

6485. New principles in heterogeneous kinetics. IMRE, L. *Acta Bolyaiana*, **2** (*No.* 1) 17–28 (1948) *In English.*—The kinetics of reactions at a solid-liquid interface are considered theoretically, with reference to 3 basic conceptions: adsorption, exchange reactions and migration of matter on to adsorption centres. Adsorption is a "transition of matter between phases in which the immediate redissolution ability of the particles remains unchanged"; the number of adsorption centres is not fixed (in contrast to classical theory) but is temp.-dependent; ion-exchange equilibrium consequently shows a temp. coeff. Applied to the problem of crystal growth the theory shows that the Nernst–Brunner equation (I) is valid only for highly supersaturated solutions and that for low supersaturations it is widely in error. For the electrolytic precipitation of Ni, the theory predicts the current density far more accurately than does I. S. J. G.

541.124 : 530.145

6486. The quantum mechanics of chemical kinetics of homogeneous gas phase reactions. I. General considerations. GOLDEN, S. *J. Chem. Phys.*, **17**, 620–30 (*July*, 1949).—From the zeroth order Born–Oppenheimer approximation to the wave functions of a molecular system and the first order time-dependent perturbation theory of quantum mechanics it has been possible to deduce: (1) the adiabatic hypothesis; (2) the dependence of the rate of homogeneous gas phase chemical reactions upon the composition of reaction mixtures; (3) the condition for zero net rate of reaction, which corresponds precisely to the statistical mechanical condition for equilibrium; (4) the dependence of the chemical reaction rate upon the temperature. Heuristic considerations transcribe the quantum mechanical result into terms of t collision theory and the activated complex theory chemical reactions.

541.124 : 530.1

6487. The quantum mechanics of chemical kineti of homogeneous gas phase reactions. II. Approx mations for displacement reaction between an ato and a diatomic molecule. GOLDEN, S. AND PEISE A. M. *J. Chem. Phys.*, **17**, 630–43 (*July*, 1949). The quantum mechanics of a displacement reactio $AB + C \rightarrow A + BC$, has been considered a the results have been applied to the reactio $H_2 + Br \rightarrow H + HBr$ at 500°K. The potent energy of the reacting system is based upon t London approximation as modified by Eyring a Polanyi. The absolute rate has been found to be sensitive function of the coulombic energy fractio when this fraction is taken to be 30%, the absolu rate is in essential agreement with the observed valu This agreement can only be regarded as fortuitou however. Several results have been derived which a not sensitive to the fraction of coulombic energy a furnish, therefore, a more stringent test of the prese formulation. It has been found that the variation the absolute rate with temp., as calculated at 500° compares favourably with the observed variatio Approximately 95% of the rate comes from H mo cules in the first excited vibrational state. T contribution from H molecules in various rotation states is given. The distribution of the initia formed HBr molecules has been found to be rep sentable by a pseudo-canonical distribution functi of the rotational quantum number, in which t "rotational temp." is approximately ½ the init temp.

541.124/.128 : 533.5

6488. Reactions of metals in high vacua. GU BRANSEN, E. A. AND ANDREW, K. F. *J. Phys. Co Chem.*, **53**, 690–711 (*May*, 1949).—The nature chemical reactions occurring in vacuum and at hi temp. on various metals is considered. These actions are grouped into 3 classes: (1) those that fo a gas as a result of a reaction; (2) those that react w gases in the vacuum; and (3) those that exchange o gas for another as a result of chemical reactio Equilibria calculations are made where data a available on the reactions for the metals Zr, W, H Cr and Mg. The various reactions are discussed sources and sinks in high-vacuum technique. apparatus is described for studying these reactions temps. to 1 200°c and at pressures of 10^{-6} mm Hg or better. A new type of high-temp. vacu furnace tube is briefly described, which can be sea to Pyrex and is vacuum-tight at 1 200°c. Results a presented on the following problems: (1) the vacu

idation of Zr, W, Mo and mild steel; (2) the formation of CO by the reaction of C in the metal with the rface oxide for the alloy Nichrome V; (3) the latilization of molybdic oxide and tungstic oxide; d (4) the oxidation and evaporation of Mg. A.

541.126 : 531.768

89. Improved operation of the ballistic mortar for termining the "power" of high explosives. TAYLOR, AND COOK, J. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 6–8 (*Aug.*, 1949).—The strength or "power" of a gh explosive is determined by measuring the angle recoil produced by a 10 g charge of the explosive ed in a ballistic mortar, and is expressed as a rcentage of that of polar blasting gelatine. The perimental procedure is described, together with a de-rule for facilitating routine calculations, and the ethods adopted for extending the useful life of the paratus by reducing wear and erosion and compensating for the increase in bore of the mortar. The ecision of the ballistic mortar is of the order of 5–1·0% of the magnitude of the observed values. A.

541.127

490. A method of estimating and minimizing the ror of measurement of the rate of a radio-active change reaction. DAVIDSON, N. AND SULLIVAN, H. Note in *J. Amer. Chem. Soc.*, **71**, 739–40 (*Feb.*, 949).—For a radio-active exchange reaction between vo components in chemical equilibrium the activity f either component varies exponentially with time. rrors in the rate constant, due to error of radioassay, can be estimated as a function of the extent of change and suitable equations for this are put orward. It is also possible from these equations to lect the optimum degree of exchange in order to inimize the error. W. R. A.

541.127 : 539.155.2

491. An effect of isotopic mass on the rate of a eaction involving the carbon–carbon bond. YANKWICH, P. E. AND CALVIN, M. Letter in *J. Chem. hys.*, **17**, 109–10 (*Jan.*, 1949).—If a symmetrical icarboxylic acid is radioactively labelled in only one COOH group, and is thermally decomposed to give monocarboxylic acid and CO_2, the CO_2 evolved ould be impoverished, and the mono-acid would be nriched in the label. Experiments were carried out ith malonic acid and with bromomalonic acid, and he frequency of rupture ratios were obtained. These atios, 1·12 for malonic acid and 1·4 for bromomalonic acid, are considerably larger than any isotope ffects that have been observed in chemical equilibria. A. J. M.

ELECTROCHEMISTRY 541.13

541.133

492. The high field conductance of some paraffin hain electrolytes. ADCOCK, W. A. AND COLE, R. H. *. Amer. Chem. Soc.*, **71**, 2835–8 (*Aug.*, 1949).—A idge circuit method using a square voltage pulse has een described which is suitable for measuring the igh field conductance of colloidal electrolytes. The hape of the output pulse shows that there is no time delay $> 0{\cdot}1\ \mu$sec in the establishment of the high field conductance upon the application of the square pulse. A greater time delay than this would cause a sloping of the front part of the output pulse. Preliminary data for the high field conductance of aqueous solutions of hexadecylpyridonium iodate and octadecylpyridonium iodate are presented which confirm earlier observations of the large effect produced by colloidal electrolytes at concentrations $>$ the concentration of the break point. A.

541.133.08

6493. On a method of measuring the conductivity of electrolytes by the application of induced currents in the body of the electrolyte. GILLOD, J. *Bull. Soc. Franç. Élect.*, **88**, 18–22 (*Jan.*, 1949) *In French.*—The electrolyte is placed in a rotating magnetic field and experiences a couple due to the interaction of the induced currents and the field. Expressions are presented for the electrolyte in (i) a circular tube, and (ii) a cylindrical vessel, with experimental verification for case (i). Concludes with a short review of other methods depending on induced currents but not rotating magnetic fields. R. B. S.

541.134.2

6494. The diffusion of electrolytes through organic membranes. KITTELBERGER, W. W. *J. Phys. Coll. Chem.*, **53**, 392–409 (*March*, 1949).—An expression for the rate of diffusion of an electrolyte through a membrane separating two solutions of different concentrations is derived assuming that an equation analogous to that giving the potential difference of the corresponding concentration cell applies. All the terms in the equation are known or can be measured. The experimental methods used for measuring rates of diffusion of HCl, NaCl and $CaCl_2$ through polyvinylbutyral membranes are described and illustrated. The results obtained by using the new expression and from measurements of diffusion rates by the usual analytical methods agree satisfactorily. J. O'M. B.

541.135

6495. The formula of uranyl ion. CRANDALL, H. W. *J. Chem. Phys.*, **17**, 602–6 (*July*, 1949).—The exchange of O between uranyl ion and water was studied using O^{18} as a tracer. The results showed that the formula of uranyl ion in dilute HCl solution is UO_2^{++}, neglecting any anion complexing, as distinguished from $U(OH)_4^{++}$, unless in $U(OH)_4^{++}$ two of the O atoms are much more weakly bonded than the other two. The UO_2^{++} ion is covalently bonded in dilute HCl solution as well as in crystalline uranyl chloride. The Raman spectrum of uranyl perchlorate was measured and the available Raman spectra of uranyl salts are interpreted considering the effects of complex ion formation. A.

541.135

6496. Thermal diffusion potentials in non-isothermal electrolytic systems. TYRRELL, H. J. V. AND HOLLIS, G. L. *Trans. Faraday Soc.*, **45**, 411–23 (*April*, 1949).—It is shown that a thermodynamic approach and rate process theory lead to the same expressions for the thermal diffusion potential, $J.\ d\phi^0/dT + J$ can be evaluated by an extrapolation method using a modified Eastman–Wagner equation, where $d\phi^0/dT$ is the true temperature coefficient of the standard

electrode. Results obtained from studies of Ag, Ag–AgBr and Ag–AgCl electrodes in appropriate aqueous halide and nitrate solutions show that the observed e.m.f. is a linear function of the temp. difference in the system. J is approx. independent of the total ionic concentration and of the absolute temp., but is greatly influenced by the presence of H or OH ions because of their high rates of diffusion under a thermal gradient. J. O'M. B.

541.135 : 539.155.2

6497. Migration of ions in a counter-current as basis for an electrochemical exchange method [of isotope separation]. MARTIN, H. *Z. Naturforsch.*, **4a**, 28–37 (*April*, 1949) *In German.*—Theoretical foundations of an electrolytic counter-current method for obtaining high concentration of isotopes. The single separation factor (q) depends upon the chemical exchange equilibrium between ions and neutral particles (or between various kinds of ions) of a dissolved isotopic electrolyte. The counter-current which causes the single separation factor to become the separation factor Q ($= qf$) is due to the migration of ions in a liquid current where the mixed element about to be separated does not show any transference phenomenon. The method is explained on the example of the electrolysis of a $MgSO_4$ solution. The calculated values of the multiplication factor (f) are, as could be expected, unusually great. It has been found that the final separation factor $(Q)_e$ passes through a max. when the electrolysis field intensity increases. The optimum value of field intensity enables one to estimate the velocity of the fundamental ion-exchange reaction. F. L.

541.135.3

6498. Investigations of galvanic cells with solid and molten electrolytes. HAMER, W. J. AND SCHRODT, J. P. *J. Amer. Chem. Soc.*, **71**, 2347–52 (*July*, 1949).—Data are presented for the galvanic cell, Mg : solid or molten electrolyte : MnO_2 : C over a temp. range extending from room temp. to and above the m.p. of the solid. Several electrolytes were studied with NaOH being the best. The cell has open-circuit voltages which increase as a function of temp. However, the cell does not sustain a voltage until the m.p. of the electrolyte is reached and exceeded. Cells of this type may be activated by heat. The difference between the open- and closed-circuit voltages of the cell becomes negligible at temps. considerably above the m.p. of the electrolyte. The cell reaction was postulated for an electrolyte of molten sodium hydroxide and was confirmed in part by X-ray diffraction studies. A.

541.135.5

6499. On the asymmetry of electrodes of the second class. IMRE, L. AND SARUSI, F. *Acta Bolyaiana*, **1** (*No.* 1) 15–26 (1946) *In English.*—Electrochemical potentials between polar crystals and very dilute ionic solutions do not always conform to Nernst's equation, and this is ascribed to the different adsorptions of cations and anions on the crystal surfaces. Extensive potential measurements are reported for AgCl, AgBr, AgI, $PbCrO_4$, $BaSO_4$ and $PbSO_4$ in solutions containing various small concentrations of either the cation or the anion of these salts. For instance the potentials for AgI in $AgNO_3$ solutions and in K solutions at concentrations from 4×10^{-9} N t 5×10^{-6} N are given relative to the potential of Ag in pure water solution. Corresponding adsorptio measurements were made on AgCl, AgI, PbCr and $BaSO_4$ using microanalytical, conductimetric, a radioactive indicator methods. The results agre with calculations based on an expression derived b Imre [*Múzeumi Füzeťek, Kolozsvár* (*Cluj*) **1** (*No.* 1 (1943)]. A semi-quantitative treatment is given fo AgI and the applicability of Nernst's equation in th presence of added iodide ions is explained. J. O'M.

541.135

6500. A study of metallic electrodes prepared b sublimation. BRADSHAW, B. C. Letter in *J. Chem Phys.*, **17**, 344 (*March*, 1949).—The electrode prepared by vacuum subliming pure Zn on Pt, we placed in a dilute solution of pure ZnCl saturate with basic zinc carbonate, air being excluded. Th difference between the e.m.f.s of these cells wa usually < 25–30 μV. The electrodes were free fro strain and reversible. J. A.

COLLOIDS DISPERSE SYSTEMS 541.18/.18

541.18 : 535.4

6501. Light scattering in soap solutions. DEBYE, P *J. Phys. Coll. Chem.*, **53**, 1–8 (*Jan.*, 1949).—Measure ments of refractive index increments and of turbidit [Abstr. 1502 (1947)] have been made on solutions o cationic soaps, e.g. *n*-alkyltrimethylammonium bro mides. The influence of added electrolytes and o alkyl chain length has been investigated. The excess turbidity of solutions over that of water is almos negligible up to a critical concentration (c_0), bu beyond this point turbidity rapidly increases. Th logarithm of c_0 varies linearly with the number of atoms in the chain. Values of the molecular weigh of micelles are derived. The micellar mol. wt. o dodecylamine hydrochloride is 12 300 correspondin with a conglomerate of 55 single molecules. Th micellar weight is raised by the addition of electro lytes, the extent by which it is raised being controlle by the concentration of added ion of charge opposit to that on the micelle. A tentative theory of micel structure is proposed. W. R.

541.18 : 539.172.2

Radiocolloidal behaviour of some fission product *See Abstr.* 6438

541.18.02 : 541.18

6502. Lamellar and other micelles, and solubilizatio by soaps and detergents. MCBAIN, J. W. AND HOFF MAN, O. A. *J. Phys. Coll. Chem.*, **53**, 39–55 (*Jan* 1949).—Further X-ray studies of the structure o micellar colloids are reported. 4 detergents, in cluding sodium desoxycholate, which for ster reasons are not expected to give lamellar micelle do not in fact show a long spacing. Hexanolamin oleate appears to give inverted micelles in benzen Results obtained with cetylpyridinium chloride an potassium laurate agree with the view that the long

ıcing is micellar rather than an average distance ween independent particles. Solubilization of nethyl *o*-phthalate occurs by attachment to external lar groups and leads to breakdown of the original nellar micelles. R. F. B.

541.182

03. Interference refractometry of colloidal solu-ns. Boutaric, A. and Berthier, P. *C.R. Acad. i., Paris*, **228**, 1009–11 (*March* 21, 1949) *In French.*—ing transparent solutions of Al_2O_3, ThO_2 and O_2 and an interference refractometer, the influences heating, of adding another colloid, and of adding electrolyte in insufficient quantity for flocculation ve been investigated. W. R. A.

541.182.3

04. Flow method of ultra-microscopic measure-ent of the particle concentrations of aerosols and her disperse systems. Deryagin, B. and Vlasenko, . *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 2) 155–8 948) *In Russian.*—The principle of the method nsists in counting the particles in a continuous w passing at a certain moment a lit-up zone in the rection of the ray of vision. By dividing the total mber of flashes observed in the field of vision every ne a particle passes the lit-up zone, by the volume aerosol flowing through the field, the particle ncentration is obtained. This method has proved be free of the serious drawbacks, systematic errors d wastefulness of time of earlier methods. The paratus is described, theory and an example measurement of particle concentration of an oil mist) e given. B. F. K.

541.182 : 539.26

505. Micelles in non-aqueous media. Mattoon, . W. and Mathews, M. B. Letter in *J. Chem. hys.*, **17**, 496–7 (*May*, 1949).—Preliminary results of nall-angle X-ray scattering and electrical trans-rence experiments on solutions of Aerosol OT in dodecane—both alone and with solubilized water—e given. The indications are that the micelles are herical. R. F. B.

541.182.5

506. A study of diffusion in agar gels by a light sorption method. Felicetta, V. F., Markham, . E., Peniston, Q. P. and McCarthy, J. L. *J. Amer. hem. Soc.*, **71**, 2879–85 (*Aug.*, 1949).—Rapid and cile procedures have been developed for study of ffusion in gels by a direct scanning light absorption ethod, using a quartz spectrophotometer. The ourse of diffusion in the gels studied is found to be in greement with particular solutions of the differential iffusion equation which satisfy the extant boundary onditions. Results obtained for the dyes Orange II nd Azogrenadin S indicate that there is no mechanical indrance to diffusion by the gel structure for the nge of agar concentrations investigated. Dependence f the rate of diffusion on agar concentration occurs, owever, for the amino acid tryptophan and the dye enzopurpurin 4B. These two substances contain asic groupings and hindrance to diffusion may result om salt formation with acidic groupings in the agar ructure or else from adsorption. Extraction experi-ents on agar gels show that the agar used is not omogeneous with regard to solubility and that the viscosity of the fluid in the gel is made ⩾ that of water by reason of the presence of dissolved agar molecules. Deviation of diffusion coeffs. in gels from reported values in aqueous solution can be explained on this basis. By appropriate experimentation in view of the above factors, absolute values for the diffusion coeffs. of molecularly dispersed light absorbing substances can be obtained in good agreement with reported values in aqueous solution. Relative values can be obtained with a precision which compares favourably with the elaborate solution methods. A.

541.182.6

6507. Comparative electron and light microscopic investigations of tactoid structures in V_2O_5-sols. Watson, J. H. L., Heller, W. and Wojtowicz, W. *Science*, **109**, 274–8 (*March* 18, 1949).—The development, and transformation, with time of tactoid structures in a 2% V_2O_5-sol have been studied by means of the electron microscope and the results correlated with observations made with the optical polarizing microscope. Data from electron diffraction and X-ray diffraction are also considered. The electron microscope shows the typical spindle-shaped tactoids, but they are extremely thin and it appears that the bundles of rods forming the three-dimensional tactoid collapse on drying to give thin films of rods which retain the tactoid outline. The rod-like crystals of a 30-day-old sol show curious cross markings which by means of shadow-casting show up as peaks 65 Å wide alternating with valleys 35 Å wide. Electron bombardment appears to have no effect on these specimens. J. I.

541.182.7

6508. The first approximate conditions for the formation of liquid crystals in solution. Jury, S. H. and Ernst, R. C. *J. Phys. Coll. Chem.*, **53**, 609–24 (*May*, 1949).—The vapour pressures of aqueous solutions of amaranth (0–0·16 *M*) and of naphthol yellow S (0–0·22 *M*) at 20°c are reported. These reveal phase transformations which are discussed in the light of the Debye–Hückel theory. R. F. B.

ADSORPTION 541.183

541.183

6509. The relation between the B.E.T. and Langmuir multilayer adsorption equations. Keenan, A. G. *Nat. Res. Coun. Can. Publ.* (*No.* 1780) 2 *pp.* (1948).—The isotherm equation of the Brunauer–Emmett–Teller theory [Abstr. 488 (1938)] was obtained from a generalization of Langmuir's treatment of monomolecular adsorption [Abstr. 1279 (1918)]. It is now shown that Langmuir's equation for multimolecular adsorption [equation (2) in above reference] can be transformed directly into the usual form of the B.E.T. equation. J. I.

541.183

6510. Extension of Fowler's treatment of surface tension to physical adsorption. Hill, T. L. Letter in *J. Chem. Phys.*, **17**, 668–9 (*July*, 1949).—Theoretical. The free volume model of a liquid [Abstr. 1785 (1948)]

is applied to Fowler's treatment of surface tension [Abstr. 1550 (1937)]. An adsorption isotherm equation is derived which is identical with that obtained from an application of the free volume model to an adsorbed liquid layer [following Abstr.]. J. I.

541.183

6511. Physical adsorption and the free volume model for liquids. HILL, T. L. Letter in *J. Chem. Phys.*, **17**, 590 (*June*, 1949).—Theoretical. An extension of previous work [Abstr. 1785 (1948)], in which the method involving the free volume model of a liquid is applied to a "liquid-like" adsorbed layer. See Halsey, G. [Abstr. 326 (1949)]. J. I.

541.183 : 531.728 : 539.217

6512. Capillarity and surface area of charcoal. PIERCE, C., WILEY, J. W. AND SMITH, R. N. *J. Phys. Coll. Chem.*, **53**, 669–83 (*May*, 1949).—Evidence is presented in support of the view that adsorption by charcoal is due chiefly to capillary condensation rather than to formation of a surface layer, as in non-porous adsorbents. The forces causing capillary condensation at low pressures are of the same type as those which cause multilayer adsorption on a plane surface, but because of the effects of opposite walls they are stronger at a distance of several molecular diameters from the substrate than is found for a plane surface. If capillary condensation occurs, it is not possible to determine the surface area of a porous solid from an adsorption isotherm and the commonly accepted values are much too large. In capillaries a few molecular diameters in width the Kelvin equation is not applicable. Retentivity is greater for slightly activated samples than for more highly activated ones. A.

541.183 : 536.422

6513. Evaporation of polar hydrocarbon monolayers. KARLE, J. Letter in *J. Chem. Phys.*, **17**, 500 (*May*, 1949).—Monolayers of cerotic acid and *n*-octadecylamine on soda glass were evaporated and the rate of decrease of scattered electron density relative to the substrate was studied in an electron diffraction apparatus. The angle of tilt of the molecules remains constant, indicating that evaporation takes place from the edges of patches of monolayer. When the relative amount of material evaporated is small it was found that the evaporation rate followed the rate equation for a first order reaction. Application of the theory of such reactions to the evaporation process leads to a value of 6 k.cal for the activation energy of evaporation of cerotic acid. This compares with an estimated value of 20 k.cal for the binding energy of a molecule of this acid within a film on Pt [Bigelow, Pickett and Zisman, *J. Coll. Sci.*, **1**, 513 (1946)], and with 6 k.cal the estimated value of the binding energy of a carboxyl group on Pt. This is further evidence that the evaporation takes place from the edges of patches since the evaporation energy is $\ll$ than the intermolecular binding energy. [See Abstr. 2899 (1946), 2260 (1947)]. J. I.

541.183.02

6514. Adsorption of the oxides of nitrogen. I. The adsorption of nitrogen dioxide-nitrogen tetroxide by rutile and silica gel; preliminary magnetic susceptibility measurements of the adsorbed layers. REYERSON, L. H. AND WERTZ, J. E. *J. Phys. Coll. Chem.*, **53**, 234–4 (*Feb.*, 1949).—The adsorption of the NO_2–N_2O_4 system by silica gel was investigated by a gravimetric method at 30·05°C and 49·16°C. Rutile was measured at −15°, 10·39°, 30·43° and 49·21°C. Some preliminary measurements of magnetic susceptibility were made in an attempt to discover the nature of the adsorbed layers. The adsorption results for silica gel indicate multimolecular layer formation of N_2O_4. Details of the apparatus and methods are given. J.

541.183.0

6515. Physical adsorption. III. A simplified equation of state at high pressures and its application to surface films on liquids and solids. ROSS, S. AND OLIVIER, J. P. *J. Chem. Phys.*, **53**, 306–12 (*Feb.*, 1949).—The Amagat equation is equivalent to $\{p + a'/(V_m - b')\}(V_m - b') = RT$ (p = pressure; V_m = molecular volume, b = incompressible volume per mole, a' = constant). The Schofield–Rideal equation for films on water $\pi(\sigma - \beta) = ikT$ is equivalent to $\{\pi + \alpha/(\sigma - \beta)\}(\sigma - \beta) = kT$ (π = surface pressure; σ = area; β = incompressible area; k = gas constant, all per molecule; α is a constant and i is a constant < 1), i.e. to $\pi(\sigma - \beta) = kt - \alpha \ldots$ (1). If a first order transition occurs between a gassy (α_2, β_2) and a condensed (α_1, β_1) adsorbed phase, each of which gives a linear $\pi\sigma$–π isotherm, the heat of transition ΔH can be calculated by integration of the two-dimensional Clausius equation with substitution for π from (1). This gives $\Delta H = \{(\beta_2 - \beta_1)\pi + (\alpha_2 - \alpha_1)ln\pi\}/lnCT$ (C = constant). It has been applied to films of ethyl palmitate, α-monopalmitin, and pentadecylic acid on aqueous substrates and to heptane vapour adsorbed on solid ferric oxide, giving ΔH as 4·2, 3·0, 8·0 and 11·5 kcal/mole respectively. S. J. G.

541.183.0

6516. On physical adsorption. IV. ROSS, S. *J. Phys. Coll. Chem.*, **53**, 383–91 (*Feb.*, 1949).—The theory of multilayer adsorption proposed by Hüttig is compared with the well-known theory of Brunauer, Emmett and Teller (B.E.T.). The experimental adsorption isotherms used for the comparison were obtained from low-pressure ethane adsorption on NaCl samples at the temp. of liquid O and in addition, the data of Hüttig and Pietzka, for adsorption at room temp. of ethanol and methanol on silica and rutile, are used. Hüttig's theory fits the experimental results more accurately than the B.E.T. theory. Suggestions are made for the modification of Hüttig's theory whereby still better agreement with the experimental data would be obtained. J.

541.183.2

6517. Adsorption of gas mixtures. Nitrogen–oxygen on anatase. ARNOLD, J. R. *J. Amer. Chem. Soc.*, **71**, 104–18 (*Jan.*, 1949).—Adsorption measurements were made at 78·2°K by a flow method, using a few definite gas compositions at various pressures. Selective adsorption of N was found at low coverages. Comparison with the extended Brunauer–Emmett–Teller theory shows qualitative disagreement, but the use of a "liquid entropy" model gives semi-quantitative agreement with experiment. L. G. C.

541.183.26

18. Physical adsorption from mixtures of gases. Oxygen–nitrogen and oxygen–argon on chromic de gel at −185·6°. WHITE, L., JR. AND SCHNEIDER, H. *J. Amer. Chem. Soc.*, **71**, 2593–600 (*Aug.*, 19).—Adsorption isotherms of binary mixtures of and N on chromic oxide gel at −185·6° have been asured and compared with Hill's extension of the .T. theory. With allowance for capillary con- nsation, the theoretical and experimental isotherms ree semi-quantitatively for both mixtures over the ssure range investigated. A.

541.183.56 : 533.75

A kinetic theory of adsorption. *See Abstr.* 6021

ATOMIC THEORY 541.2

541.24

19. Molecular weight determinations by the piestic method. CLAESSON, S. *Ark. Kemi.*, **1** (*per* 11) 81–5 (1949) *In English.*—A modification of utchard's method is described which enables the e of volatile liquids as solvents. W. R. A.

541.24 : 535.434

20. The scattering of light by sodium silicate utions. DEBYE, P. AND NAUMAN, R. V. Letter in *Chem. Phys.*, **17**, 664 (*July*, 1949).—Measurements turbidity lead to calculated values of the molecular ight of Na_2SiO_3 indicating dissociation rather than gregation. Much larger molecules are found in utions with a SiO_2/Na_2O ratio of 3·3. S. T. H.

CHEMICAL STRUCTURE 541.4/.6

541.5 : 539.132

Directed valence as a property of determinant wave ctions. *See Abstr.* 6352

541.57

21. The strength of the hydrogen bond in water. ARCY, A. W. Letter in *J. Chem. Phys.*, **17**, 210–11 *b.*, 1949).—Determinations of the energy of mation of H-bonds in ice assume that the non-H ding energy in water is the heat of sublimation ich ice would have if there were no H-bonds in it 1 is estimated from the heats of sublimation of S, H_2Se and H_2Te. The validity of these assump- ns is criticized: ice crystals have 4 nearest neigh- urs compared with 12 in the crystals of the other lrides and further a non-H-bonded water would e a density at room temp. $< \frac{1}{2}$ that of actual water. real ice the closer approach of nearest neighbours ates large repulsive energy and consequently ntributes markedly to the energy of ice. The dipole ment of ice has been calculated by means of an ation connecting the energy of sublimation and the rmolecular distance and comprising terms for ndon and repulsive energies. It is assumed that dipole energy is the sum of the energies of the H-bonds of the molecule. A value of 6·4 ± 0·5 kg.cal per bond has been obtained for the dipole energy; this is some 2 kg.cal per mol. > the previously estimated value. W. R. A.

541.57

6522. The dissociation energy of the C–N bond in benzylamine. SZWARC, M. *Proc. Roy. Soc. A*, **198**, 285–92 (*Aug.* 15, 1949).

541.64 : 519

Use of statistical inequalities in polymer research. *See Abstr.* 5866

541.64

6523. Statistical theory of linear polymers. I. Intramolecular statistics. KUBO, R. *J. Phys. Soc. Japan*, **2**, 47–50 (*May–June*, 1947) *In English.*

541.64 : 539.31

6524. Statistical theory of linear polymers. II. Elasticity of vulcanised rubber. KUBO, R. *J. Phys. Soc. Japan*, **2**, 51–6 (*May–June*, 1947) *In English.*—Theoretical. In the development of the theory it is assumed that elastic deformations are reversible, that only small plastic deformation occurs, that thermal equilibrium is easily established, that only small changes in internal energies are experienced, and that crystallization resulting from deformation has a negligible effect. W. R. A.

541.64 : 535.55

6525. Statistical theory of linear polymers. III. Double refraction (in rubber). KUBO, R. *J. Phys. Soc. Japan*, **2**, 84–9 (*July–Aug.*, 1947) *In English.*—An extension of previous work by which the double refraction of deformed rubber is explained. W. R. A.

541.64

6526. Statistical theory of linear polymers. IV. Effects of hindrance for internal rotation. KUBO, R. *J. Phys. Soc. Japan*, **3**, 119–25 (*March–June*, 1948) *In English.*—A further mathematical extension of previous work on the intramolecular statistics of linear polymers which takes account of the hindering potential for internal rotation. W. R. A.

541.64

6527. Molecular interaction in high-polymer solutions. VOET, A. *J. Phys. Coll. Chem.*, **53**, 597–608 (*May*, 1949).—For concentrations below a critical value the diclectric constants of solutions of polystyrenes and polyisobutylenes in hydrocarbon solvents equal the value for the solvent; but at higher concentrations the values for solutions at rest rapidly increase with increase in concentration, whilst the same solutions subjected to shearing stresses give values considerably lower. High molecular weight is associated with low critical concentration. Below this critical concentration Newtonian flow is evidenced, whereas above it there is always plastic flow. Molecular independence exists below the critical concentration, but above it agglomeration occurs and this is interpreted in terms of Bruggeman's views and the London–van der Waals' concept of molecular association. W. R. A.

541.64

6528. Viscosity-molecular weight relation for polybutadiene. Effect of polymerization temperature. JOHNSON, B. L. AND WALFANGEL, R. D. *Industr. Engng Chem.*, **41**, 1580–4 (*Aug.*, 1949).—The relation

between intrinsic viscosity and number average molecular weight has been determined for emulsion polybutadiene polymerized at 3 temps. The viscosity of polybutadiene made at 50°C and to about 65% conversion is related to molecular weight as follows: $[\eta] = 72{\cdot}5\times10^{-4}\times M^{0{\cdot}45}$. Lowering the polymerization temp. to 5°C changes the relation to $[\eta] = 26{\cdot}4\times10^{-4}\times M^{0{\cdot}55}$, while a further decrease in polymerization temp. to − 20°C results in a relationship of $[\eta] = 10{\cdot}6\times10^{-4}\times M^{0{\cdot}63}$. A similar increase in the exponent of the viscosity-molecular weight relationship is obtained for low conversion 5° and 50°C polymer. A.

541.67

6529. Structure and diamagnetic anisotropy of p-benzoquinodimethane in connection with those of p-benzoquinone. Evans, M. G., de Heer, J. and Gergely, J. *Proc. Phys. Soc. Lond. A*, **62**, 505–8 (*Aug.*, 1949).

541.67 : 541.139

6530. Action of oscillating magnetic field on certain molecules. Mastagli, P. and Mahoux, A. P. *C.R. Acad. Sci., Paris*, **228**, 1124–6 (*March* 28, 1949) *In French.*—The behaviour of some aromatic compounds in an oscillating magnetic field has been studied and is considerably modified by structural alterations in the molecule. W. R. A.

CHEMICAL ANALYSIS 543/545

545.3

6531. On the development of polarographic analysis (particularly in the field of metallurgy). Souchay, P. *Rev. Sci., Paris*, **86**, 545–70 (*July–Aug.*, 1948) *In French.*—Summary of the history, theory and practice of polarographic analysis. 87 references, 37 drawings and diagrams. F. L.

545.8 : 523.51

The neutron pile as a tool in quantitative analysis. *See Abstr.* 5888

545.82

6532. Correction for interfering absorption in spectrophotometric analyses. Tunnicliff, D. D., Rasmussen, R. S. and Morse, M. L. *Analyt. Chem.*, **21**, 895–900 (*Aug.*, 1949).—An algebraic method for the correction of spectrophotometric data for the effect of interfering absorption is based on the assumption that the optical density of the interference can be represented by an analytical function of wavelength, and that this function does not represent the optical density of any of the components being determined. The optical density is measured at a sufficient number of wavelengths to determine the constants of the function as well as the concentrations of the desired components. However, in practice, the calculation of the constants is omitted. The specific applications described are for the determination of benzene and toluene; ethylbenzene, *o*-xylene, *m*-xylene and *p*-xylene; and naphthalene. The degree of correction for different types of interfering absorption is shown by the results of the analysis of a number of synthetic samples containing interference. A.

545

6533. Design of an ultraviolet analyzer. Kivens G., Osmar, J. J. and Jones, E. W. *Analyt. Che* **21**, 769–73 (*July*, 1949).—A design is presented fo double-beam u.v. colorimeter employing interrup radiation and a tuned amplifier. Drift and noise comparatively low, and over-all stability and sensitiv are good.

545

6534. Pneumatic autodetector for infrared analysis. Miller, R. D. and Russell, M. *Analyt. Chem.*, **21**, 773–7 (*July*, 1949).—A ma difficulty in the application of the self-detect principle is the control of drift. A simple analy designed to minimize drift is described.

545

6535. Influence of background on spectrochem calibration curves. Kaiser, H. *Spectrochim. Acta* (*Nos* 3–4) 297–319 (1948) *In German.*—The follow questions are answered with regard to the influe of the background on the measurement of the int sities of spectral lines by photographic photome In which cases must the background be taken i account, and what systematic error is there of background is neglected? How can a calibrat curve in which background has been neglected, turned as a whole into a corrected one? How calibration curves in which background has b neglected, be so treated that deductions can be m in the regions of smaller concentration, when background cannot be neglected? The theory illustrated by an experimental example. A. C.

545.82 : 53

6536. Luminescent analysis of minerals. Komov G. F. *Izv. Akad. Nauk, SSSR* (*Ser. Fis.*) **13** (*No* 248–50 (1949) *In Russian.*

545.82 : 53

6537. Luminescent analysis of bitumens. Fioletc A. F. *Izv. Akad. Nauk, SSSR* (*Ser. Fis.*) **13** (*No* 254–6 (1949) *In Russian.*

545.82 : 535.37 :

6538. Luminescence analysis of optical glas Brumberg, E. M., Sverdlov, Z. M. and Timofeh T. V. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **13** (*No* 242–7 (1949) *In Russian.*—Luminescence is divi into fluorescence (duration $< 10^{-5}$ sec) and ph phorescence (duration $\simeq 10^{-2}$ sec). A "flu phosphoroscope" is described in which a high vol spark discharge between Fe electrodes provides u.v. (2 500–3 000 Å) radiation for excitation fluorescence, whilst phosphorescence is obser with the help of a separate electrode assembly toge with an occulting disc, rotated so that spark illuminated object are screened from the observe the moment of discharge. For factory con purposes a similar type of instrument, but usin Hg lamp, is described. The luminescence of the specimens is compared with that of a standard g by means of a divided viewing objective. specimens can be examined in 8 hr. The sur condition of the glass is immaterial. Luminesc phenomena are a fundamental characteristic of glass, depending on its composition and unaffe by minor variations from batch to batch. A tab given in which the 8 standard types of optical g

nufactured in the U.S.S.R. are subdivided into groups according to their luminescence reactions. me glasses are indistinguishable by this test and quire additional (refractometric) investigation. V. B.

545.82 : 537.52 : 621.316.54

39. Synchronous switches for electric spark nerators used in spectrochemical analysis. BARDÓCZ, *Publ. Univ. Tech. Sci., Budapest* (*No.* 3) 140–57 948) *In English.*—A review of the principles under- ng design of synchronous rotary switches for the ark generators used in spectrochemical analysis. e possibility of using such switches in apparatus generating a pulsating arc discharge is pointed t. Different methods of phase adjustment are cussed, also the special problems introduced by ng h.v. A special description is given of a remote ase-adjusted and voltage-controlled rotary switch 40 kV peak voltage. A. C. M.

545.828

40. The quantitative spectrographic analysis of rare earth elements. III. Determination of major stituents in complex mixtures. FASSEL, V. A. *J. Opt. Soc. Amer.*, **39**, 187–93 (*Feb.*, 1949).—Spectrographic methods applicable to the determination of major rare earth constituents in complex mixtures are described. The specific examples discussed are the determination of Yt and Gd in the concentration range of 10 to 100%. The procedures involve the high current d.c. arc excitation of rare earth oxide sample-ceric oxide-graphite mixtures. Selected lines of Ce are used as internal standards. The choice of Ce as internal standard was based on the relative ease with which any Ce, if present in a mixture, could be preferentially separated from the mixture and then reintroduced in a standard amount. Precision studies show a standard deviation of about $\pm 2{\cdot}5\%$ for single determinations. The results from a quantitative study of (*a*) vaporization rates, (*b*) intensity diagrams of the internal standard line pairs along the longitudinal axis of the arc discharge, and (*c*) the effect of large changes in excitation conditions on the intensity ratios show that this high precision can be attributed to a high degree of internal standard compensation of excitation variables. [See Abstr. 3512 (1948)]. A.

CRYSTALLOGRAPHY 548

548.0 : 536.41

41. Investigation of thermal dilatation of cubic tals. KOCHANOVSKA, A. *Physica*, **15**, 191–6 (*April*, 49) *In English.*—The thermal dilatation of chemi- ly pure Fe and Al was measured in different crystal- graphic directions. The measurements were per- med in the polycrystalline state of these metals h the aid of X-rays of 3 different wavelengths. using the radiation of these wavelengths it was ssible to determine with sufficient precision the rmal dilatation for Fe in the directions (013) and 2) and for Al in the directions (024), (115) and (222). e results in a temp. range of 22–366°c showed in case of Fe an anistropy of the thermal dilatation, differences measured being above the possible ors of the measurements. In the case of Al no ferences of that kind were detected below 220°c. e results for Fe suggest that owing to the anisotropy the thermal dilatation some of the metals belonging the cubic crystallographic system are actually not cisely cubic. A.

548.0 : 537.311.31 : 536.413

42. Some anisotropic properties of gallium. WELL, R. W. *Nature, Lond.*, **164**, 153–4 (*July* 23, 49).—A single crystal of Ga of high purity was wn in glass tubing bent to comprise 12 sections ing 4 directions in each of 3 mutually perp. planes. ing Pt potential leads the electrical resistivities were ained and a conductivity ellipsoid constructed m which the settings for growing single crystals the 3 axial directions were determined. Single stal rods $\sim 0{\cdot}45$ cm diameter and 15 cm long re grown in these directions, and the resistivities — 60, 0 and 20°c, and the mean expansion coeff. ween 0 and 20°c measured. The resistivity values ee with Bridgman's value for the liquid state, but indicate a lower value for the polycrystalline solid and a ratio of the resistivities liquid/solid at the melting point of $\sim 5/3$ instead of 1/2. A table of extreme values and their ratios for the electrical resistivities of single crystals of several different metals is included, showing that Ga has an unusually high ratio. S. W.

548.1

6543. On the application of the general theory of symmetry to crystallography. JASKOWSKI, S. *Experientia*, **5** (*No.* 2) 66–8 (1949) *In French.*—The crystal classes are regrouped with new names and symbols. A. J. C. W.

548.1

6544. On the morphology of some crystals of pseudosymmetric structure. GARRIDO, J. *Acta Cryst.*, **2**, 197–201 (*Aug.*, 1949) *In French.*—A study of the morphology of chalcopyrite, stannite, wulfenite and manganite shows that the existence of a structural pseudo-symmetry has an influence on the relative importance of the different forms in these crystals. In particular, the reticular planes possessing, in relation to the pseudo-symmetry, a spacing which is a submultiple of the true spacing correspond to forms whose development is in general less common than that predicted by the law of Donnay and Harker. A.

548.4

6545. One-dimensional dislocations. II. Misfitting monolayers and oriented overgrowth. FRANK, F. C. AND VAN DER MERWE, J. H. *Proc. Roy. Soc. A*, **198**, 216–25 (*Aug.* 15, 1949).—The equations derived in Pt. I [Abstr. 5779 (1949)] for a one-dimensional dislocation model are applied to the case of a monolayer on the surface of a crystalline substrate, particularly when the natural lattice spacing of the monolayer

differs from that of the substrate. Justification is given for this extension of the equations to the two-dimensional case. It is shown that the theory predicts a certain critical amount of misfit (9% difference in lattice spacing in a simple case) below which the monolayer in its lowest energy state is deformed into exact fit with the substrate, and above which it is only slightly deformed in the mean, having many dislocations between it and the substrate. The energy of adsorption as a function of misfit is also calculated, becoming almost constant above the critical limit. Up to a larger critical misfit (about 14% in the same simple case) the monolayer can be deposited metastably in exact fit on the substrate, at sufficiently low temp. Since the dislocated layer is mobile on the surface, completely oriented overgrowth of one crystal on another can only be expected if the first monolayer can be formed over the complete surface under sub-critical conditions. This is in general agreement with observation. A.

548.5

6546. How crystals grow. RIDEAL, E. K. *Nature, Lond.*, **164**, 303–5 (*Aug.* 20, 1949).

548.522

6547. Contributions to the knowledge of crystal growth processes. GYULAI, Z. *Z. Phys.*, **125** (*Nos* 1–3) 1–17 (1948) *In German.*—NaCl crystals were grown from the vapour phase by heating a bead of salt close to fine Pt and quartz wires. Crystal growth took place only when the temp. of the wire exceeded 200°C. The effect of the vapour density on the shape of the crystals is discussed. Crystals were also formed on the bead from the vapour and by surface migration of ions. This migration depends on the temp. and may partly be due to a molecular layer of solvent. Photographs are given of the various crystal types. J. A. F.

548.523

6548. The mutual habit modification of sodium chloride and dipolar ions. FENIMORE, C. P. AND THRAILKILL, A. *J. Amer. Chem. Soc.*, **71**, 2714–17 (*Aug.*, 1949).

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

6549. On a possible zonal structure of the energy spectrum [of Mg_3Sb_2]. KONTOROVA, T. A. *J. Tech. Phys., USSR*, **18**, 1478–84 (*Dec.*, 1948) *In Russian.*—An application of the method of the "weakly-bound" electrons to the investigation of intermetallic compounds, of which Mg_3Sb_2 is a typical representative. The paper supplies a theoretical interpretation of the experimental work of Boltaks and Zhuse [Abstr. 1904 (1948)]. The question of the existence of an energy "zone" for Mg_3Sb_2 is answered in the affirmative, the number of places in it being equal to the number of valency electrons. This conclusion applies to the other compounds having the same hexagonal lattice as the α-modification of Mg_3Sb_2 (whereas the β-modification of Mg_3Sb_2 has a different lattice), i.e. Mg_3Bi_2 and the lanthanide sesquioxide. The model of t zone given is shaped like a hexagonal disc and as its places are occupied, the compound should beha as a semi-conductor, a prediction borne out by expe ment at more normal temps. At very low temp. t compound should have bad metallic conductivit This range has not yet been investigated. T height of the prohibited zone was determined 1·08 eV. B. F.

548

6550. On the directional character of the long-ran order parameter. GOLD, L. Letter in *Phys. Rev.*, 7 1265 (*April* 15, 1949).—The degree of long-distan order in, e.g., $AuCu_3$ is a function of crystallograph direction. [See Abstr. 2363 (1943), 2697 (1946)]. A. J. C.

548

6551. Motions of molecules in condensed syste V. Classification of motions and selection rules spectra according to space symmetry. WINSTON, AND HALFORD, R. S. *J. Chem. Phys.*, **17**, 607– (*July*, 1949).—A classification of the motions of crystal is made on the basis of space symmetry, w the aid of the Born–Karman boundary condition It is shown that the selection rules for fundamenta arising from this classification are the same as tho derived by the unit cell analysis of Bhagavantam a Venkatarayudu. A relation between the unit c and site analysis is investigated which makes it possi to obtain the unit cell results by means of the usua simpler site method. A space symmetry criterion the appearance of composite transitions is establishe and some of the effects expected on the basis of t criterion are discussed. The character tables space groups are described.

54

6552. Crystal spectra. JOOS, G. *Experientia*, (*No.* 4) 148–53 (1949) *In German.*—Qualitat discussion of energy levels in crystals. A. J. C.

548.7 : 535

6553. Note on the selection rules for ions in c stalline surfaces. NATHANS, M. W. Letter in *Chem. Phys.*, **17**, 500–1 (*May*, 1949).—Gro theoretical. Because of the non-equivalence axes $\parallel$ and $\perp$ to the surface of a crystal, degener is partially removed and the selection rules electron transitions differ from those valid in body of the crystal. Transitions $l \rightarrow l$ and $J = 0 \rightarrow$ may become possible. The theory may have ap cations to the absorption spectra of rare-earth ion A. J. C.

548.7 : 537.2

6554. A note on low frequency dispersion in io crystals. GRIMLEY, T. B. Letter in *J. Chem. Ph* **17**, 496 (*May*, 1949).—A discussion on Breckenridg paper. [Abstr. 1231 (1949)]. D. H.

548.7 : 537.311 : 539

6555. Some electronic properties of a one-dim sional crystal model. SAXON, D. S. AND HUTNER, R. *Philips Res. Rep.*, **4**, 81–122 (*April*, 1949).— Kronig-Penney model of a one-dimensional cry is studied further with the aid of the formal

f the Dirac δ-function. Both a Green's-function ethod and a scattering-matrix method are used to erive the energy levels and wave functions for the onatomic and the diatomic lattices. The scattering-atrix method is used to study the problems of a ngle impurity, both substitutionally and inter-itially located, and the coupling between impurities. the last section the general problem of a solid olution is discussed. A.

548.7 : 541.57

6556. Nature of bond in ionic crystals. KULKARNI ATKAR, S. K. AND KULKARNI, S. B. Letter in *Curr. ci.*, **18**, 130–1 (*April*, 1949).—The ionic character of lkali halide bonds has been computed from an quation involving the sum of the ionic and covalent nergies. The partial ionic character in crystals is xplained quantitatively on the basis of covalent-onic resonance in units NaX_8 or CsX_8, where X is a alogen. W. R. A.

548.7 : 77.023.4

6557. Lattice defects in silver halide crystals. MITCHELL, J. W. *Phil. Mag.*, **40**, 667–9 (*June*, 949).—A continuation of previous work [Abstr. 3624 (949)]. Tubandt's work on the electrical con-uctivity of AgCl and AgBr is re-examined and it suggested that the results are consistent with chottky's mechanism of conduction through mobile ation and anion vacant sites. The model suggested reviously for the defects responsible for the optical ensitivity of Ag halides in the presence of AgS is odified. L. S. G.

548.73

6558. Summarized proceedings of Conference of X-ray Analysis Group on Macromolecular Structure—York, November 1948. KENDREW, J. C. AND MACARTHUR, I. *J. Sci. Instrum. Phys. Ind.*, **26**, 80–5 (*Aug.*, 1949).

548.734

6559. The determination of relative phases of Fourier coefficients from X-ray diffraction data. MCLACHLAN, D., JR. *J. Appl. Phys.*, **20**, 295 (*March*, 949).—Inequalities of the type $4F_h/F_{3h} + 3F_h > 0$ re derived, where F_h is the structure amplitude of the 00 reflection from a centrosymmetric crystal in which he atomic scattering factors are equal to the atomic umbers. Similar, more complicated, expressions nay be derived for the *hk*0 and *hkl* reflections. See Abstr. 3015 (1948)]. A. J. C. W.

548.734

6560. Table of interplanar spacings for different target materials for the back-reflection region. BEATTY, S. VAN D. Letter in *J. Appl. Phys.*, **20**, 415 (*April*, 1949).—The tables give *d* in Å to 4 or 5 significant figures at intervals of 0·1° in 2θ for Mo, Cu, Co, Fe and Cr $K\alpha_1$. A. J. C. W.

548.734

6561. On ambiguity in crystal-structure determination. MENZER, G. *Z. Naturforsch.*, **4a**, 11–21 (*April*, 1949) *In German.*—Patterson [Abstr. 1710 (1944)] has shown that in some cases different, so-called *homometric*, atomic arrangements give the same X-ray diffraction pattern. The conditions for the occurrence of homometric arrangements are discussed, and comparatively simple criteria are developed to decide whether a proposed arrangement has a homometric partner. The conditions for homometry are stringent, and it is probably not a widespread phenomenon. A. J. C. W.

548.734

6562. Possible X-ray determination of a centre of symmetry. WILSON, A. J. C. *Research, Lond.*, **2**, 246 (*May*, 1949).—The probability that the intensity of an X-ray reflection lies between I and $I + dI$ is $\Sigma^{-1} \exp\{-I/\Sigma\}dI$ for a non-centrosymmetric crystal and $(2\pi\Sigma I)^{-\frac{1}{2}} \exp\{-I/2\Sigma\}dI$ for a centrosymmetric crystal, where Σ is the sum of the squares of the atomic scattering factors. The difference in the distribution functions may be used to determine centres of symmetry; in particular the ratio of (mean value of $|F|)^2$ to (mean value of I) has the values 0·785 and 0·637 in the two cases. Other symmetry elements produce complications which will be discussed elsewhere. A. J. C. W.

548.735

6563. One dimensional disorder in crystals and its influence on X-ray diffraction. I. Calculation of the degree of disorder from the X-ray intensity. JAGODZINSKI, H. *Acta Cryst.*, **2**, 201–7 (*Aug.*, 1949) *In German.*—The general theory is developed of X-ray scattering by crystals showing order in two translation directions but disorder in the third direction, the treatments previously published having proved inadequate for the interpretation of some single-crystal observations of the author. The solution of the problem is affected by the range of interaction between the arrangement of the neighbouring layers. General equations are here developed for a range of one layer. If the probability of faults is small, nearly ordered structures occur. These ordered structures are determined for a range of up to 6 layers. It is shown that the most probable layer type consisting of >6 layers of close-packed atoms is the SiC(I)-type (15 layers). A.

548.735

6564. One-dimensional disorder in crystals and its influence on X-ray diffraction. II. Calculation for disordered close-packed structure with interaction of 3 layers. JAGODZINSKI, H. *Acta Cryst.*, **2**, 208–14 (*Aug.*, 1949) *In German.*—The general theory of X-ray diffraction by a one-dimensionally disordered structure (above Abstr.) is here applied to the special case of close-packed structures having a "three-layer influence" on the arrangement of the neighbouring planes. The intensity of diffraction is expressed in terms of two quantities $\aleph_\nu$ and K_ν which are themselves functions of α and β, where $(1 - \alpha)$ is the probability that a fourth layer continues a hexagonal arrangement and β is the probability that a fourth layer continues a cubic arrangement of the 3 preceding layers. The line widths and displacements of the positions of certain reflection-maxima depend on the degree of order and so enable this quantity to be determined experimentally. A.

548.735

6565. The diffraction of X-rays by distorted-crystal aggregates. II. Diffraction by bent lamellae. WILSON, A. J. C. *Acta Cryst.*, **2**, 220–2 (*Aug.*, 1949) *In English.*—The apparent particle size of distorted

crystallites varies from independence of θ and λ (particle-size broadening) to proportionality with $\lambda \operatorname{cosec} \theta$ (distortion broadening) as the parameter $E\eta \sin\theta/\lambda$ increases, where E is a particle size and η is an average strain. For a bent "orthorhombic" lamella of thickness T with axes chosen so that z is parallel to the axis of bending, x perpendicular to the lamella, and y perpendicular to x and z, the apparent particle size ε is given by

$$\varepsilon = \frac{2T}{p}\int_0^1 \frac{\sin\,[2\pi A\xi(1-\xi)]}{2\pi A\xi}\,d\xi,$$

where $A = \dfrac{T}{p}\dfrac{|q^2 - c_{21}p^2/c_{11}|}{R}\dfrac{T\sin\theta}{\lambda}$, R is the radius of curvature, p, q, r are the direction cosines of the reflecting planes, and c_{21} and c_{11} are elastic constants. A.

548.735 : 535.4 : 537.531

X-ray diffraction by randomly oriented line gratings. *See Abstr.* 6239

548.735.4

6566. X-ray diffraction by random layers: ideal line profiles and determination of structure amplitudes from observed line profiles. WILSON, A. J. C. *Acta Cryst.*, **2**, 245–51 (*Aug.*, 1949) *In English.*—Warren's calculation [Abstr. 1399 (1941)] of the line profile for diffraction from random layers depends on the use of an approximation function. This can be avoided, and expressions found for (*a*) the ideal line profile for slow variation of the structure amplitude, and (*b*) the variation of the intensity of diffraction as a function of position along the "rod" of high intensity in reciprocal space, in terms of the layer shape and the observed line profile. The ideal line profile is, within a trigonometrical factor,

$$I(\sigma) = FF^*S_0^{\frac{1}{2}}\int_{-\infty}^{\infty} A(t)|t|^{-\frac{1}{2}}(\cos 2\pi\sigma t + \sin 2\pi\sigma|t|)dt,$$

where $S_0(=2\sin\theta_0/\lambda)$ is the perpendicular distance from the origin of the reciprocal lattice to the centre line of the "rod," $\sigma = (\sin^2\theta - \sin^2\theta_0)/\lambda\sin\theta_0$, F is the structure amplitude, and $A(t)$ is the area common to a layer and its "ghost" shifted a distance t parallel to S_0. This expression, evaluated for various layer shapes, gives intensities of diffraction slightly lower than those found by Warren and depending somewhat on the layer shape. In particular, the intensity for large negative volumes of σ is $\propto |\sigma|^{-3/2}$ multiplied by the maximum breadth of the layer. If w is measured along the "rod" from the foot of S_0, $F(w)F^*(w) + F(-w)F^*(-w)$ can be obtained by "unfolding" the observed $I(\sigma)$ by means of a double Fourier transformation. Diffraction by random layers can thus give more information than diffraction by a perfect crystal, as the latter gives FF^* only for integral values of the indices. A.

548.735.5

6567. The structure of crystals of Gros's salt, $[Pt(NH_3)_4Cl_2]Cl_2$. BOKIĬ, G. B. AND PORAĬ-KOSHITS, M. A. *Dokl. Akad. Nauk, SSSR*, **64**, 337–9 (*Jan.*, 1949) *In Russian.*—Crystallizes in yellow octahedra with refractive indices $n_o = 1{\cdot}73$, $n_e > 1{\cdot}85$. Space group is $D_{4h}^{17} = I4/mmm$. $a = 7{\cdot}44 \pm 0{\cdot}04$ Å, $c = 7{\cdot}98 \pm 0{\cdot}04$ Å, $z = 2$. Structure type $J1_3$. Atomic parameters (x, y, z) are: Pt (2), (0, 0, 0); NH_3 (8), (0·194, 0·194, 0); Cl_I (4), (0, 0, 0·281); Cl_{II} (4), (0·5, 0, 0·25). A. L. MACK

548.735.

6568. X-ray study of the distribution of crystallit dimensions in a crystalline powder. BERTAUT, F *C.R. Acad. Sci., Paris*, **228**, 492–4 (*Feb.* 7, 1949) *I French.*—[See Abstr. 2809 (1949)]. A Fourier transform discussion is given of the relation betwee the line profile and various mean values of th thickness of the crystals measured ⊥ to the reflectin planes. The analysis is applied to the 110 reflectio from a fine Fe powder. A. J. C. W

548.735.

6569. Method of correction of the profile of Debye Scherrer lines. BERTAUT, F. *C.R. Acad. Sci., Paris* **228**, 1597–9 (*May* 16, 1949) *In French.*—[See precedin Abstr.]. A Fourier-transform method is developed similar to that of Stokes [Abstr. 4039 (1948)], fo separating the experimental and diffraction broaden ings. The Fourier transforms of the broadenings t be expected from various sources are listed, and thei product is found to be in good agreement with tha found experimentally for Fe 110. A. J. C. W

548.73

6570. Diffuse scattering of X-rays by ice. OWSTON P. G. *Acta Cryst.*, **2**, 222–8 (*Aug.*, 1949) *In English.*— The diffuse scattering of X-rays by single crystals o ice has been found to be of thermal origin. Th existing theory is inadequate to explain the observa tions, and needs extending to include the effects o vibrations of shorter wavelengths. The main feature of the representation in reciprocal space of the diffus scattering are given. The amplitudes of vibration o the molecules are of the order of 0·4 Å at −5°C The strong local disturbances which cause the diffus streaks could include movements of the H atom between neighbouring O atoms. A.

548.736.

6571. The MBe_{13} compounds. BAENZIGER, N. C. AND RUNDLE, R. E. *Acta Cryst.*, **2**, 258 (*Aug.*, 1949 *In English.*—Face-centred cubic, space group $Fm3c$ 8 M in (*a*), 8 Be in (*b*), 96 Be in (*i*), isomorphous wit $NaZn_{13}$. The lattice parameters are: for M = Ce 10·375 ± 0·001 Å; Th, 10·395; U, 10·256; Zr 10·047 ($y \sim 0{\cdot}112$, $z \sim 0{\cdot}178$). A. J. C. W

548.736.3 : 539.26

6572. X-ray diffraction studies of sodium chloride sodium bromide solid solutions. NICKELS, J. E FINEMAN, M. A. AND WALLACE, W. E. *J. Phys. Coll Chem.*, **53**, 625–8 (*May*, 1949).—The X-ray diffractio patterns for 9 NaCl–NaBr solid solutions and for pur NaCl and pure NaBr were obtained. The soli solutions were observed to be single-phase, homo geneous, crystalline materials. From the diffractio patterns, the lattice spacings, densities and mola volumes were computed. Both lattice spacings an molar volumes of the solid solutions exhibit positiv deviations from additivity. A.

548.737

573. The unit cell and space group of *n*-acetyl-*l*-osylamide. CARPENTER, G. B. *Acta Cryst.*, **2**, 0 (*Aug.*, 1949) *In English.*—Tetragonal, space group $_2 2_1$, $a = 10{\cdot}84 \pm 0{\cdot}04$ Å, $c = 20{\cdot}31 \pm 0{\cdot}05$, $Z = 8$, elting point ~225°C, structure not determined. A. J. C. W.

548.737

574. The crystal structure of form *A* of potassium prate. VAND, V., LOMER, T. R. AND LANG, A. *ta Cryst.*, **2**, 214–20 (*Aug.*, 1949) *In English.*—otassium caprate, $KC_{10}H_{19}O_2$, form *A*, is mono-nic. The cell contains 4 molecules and has the mensions $a = 8{\cdot}119$, $b = 5{\cdot}650$, $c = 28{\cdot}907$ Å, $= 108° 2'$; density calculated 1·108, observed 123 g.cm^{-3}. The space group is C_{2h}^5–$P2_1/a$. Two-mensional Fourier projections show that the drocarbon chains cross each other and that the erage distance between two alternate C atoms in the ain is 2·598 Å. This is significantly > the commonly sumed distance 2·522 Å, derived from the diamond ucture. The angle of tilt of the molecules is ° 30′. A.

548.737

575. The crystal structure of aniline hydrochloride. ROWN, C. J. *Acta Cryst.*, **2**, 228–32 (*Aug.*, 1949) *English.*

548.737

576. The crystal and molecular structure of phthalene. I. X-ray measurements. ABRAHAMS, C., ROBERTSON, J. M. AND WHITE, J. G. *Acta ryst.*, **2**, 233–8 (*Aug.*, 1949) *In English.*—A compre-nsive X-ray investigation of the crystal structure of phthalene is described, in which all the reflections at lie within the reach of Cu $K\alpha$ radiation have been amined. Moving-film photographic methods and sual estimates of intensities by independent observers ere employed. From the results a total of 644 ructure factors out of a possible 832 have been aluated, giving 129 structure factors per atom of e asymmetric unit. From the earlier two-dimensional pproximation to the naphthalene structure it has been possible to assign phase constants to 612 of the factors with reasonable certainty. These results form the basis of a new three-dimensional determination of the structure. A.

548.737

577. The crystal and molecular structure of naphthalene. II. Structure investigation by the triple Fourier series method. ABRAHAMS, S. C., ROBERTSON, J. M. AND WHITE, J. G. *Acta Cryst.*, **2**, 238–44 (*Aug.*, 1949) *In English.*—A triple Fourier series investigation of the naphthalene structure is described, based on the 612 structure factors listed in Part I [previous Abstr.]. The series for the electron density has been evaluated at 54 000 points over the asymmetric crystal unit (half the chemical molecules), and the results are expressed by giving a number of sections through separate atoms at different levels, and also by giving a section through the plane of the molecule. From this map the bond lengths can be determined by direct measurement and are found to vary from 1·36 Å in the $\alpha\beta$ bond to 1·42 Å in the $o\alpha$ bond. The $\beta\beta$ bond and the central bond, oo, are both measured at 1·395 Å. These figures are probably correct to within about 0·01 Å, and appear to be in reasonably good agreement with the latest theoretical calculations. The rings are also found to be coplanar to within 0·01 Å. The bridge value of the electron density varies in the different bonds; the electron distribution and the effect of the H atoms are briefly discussed. A.

548.74

578. Anomalies in electron-diffraction Debye–Scherrer ring. HONJO, G. *J. Phys. Soc. Japan*, **2**, 133–7 (*Sept.–Oct.*, 1947) *In English.*—Rings for MgO and Sb_2O_3 show a fine structure (reflections from single crystallites split into a symmetrical group of spots) which is explained by refraction at the crystal faces. The splitting depends on the crystal shape, and the observations are in accord with cubic MgO crystals, inner potential 11 V, and octahedral Sb_2O_3 crystals, inner potential 16 V. A. J. C. W.

GEOPHYSICS 55

550.3

579. Mathematical methods in geophysics. BAR-LS, J. *FIAT Rev. German Sci.* (1939–1946) "*Applied lathematics, Part V*" [*Off. Mil. Govt. Germany*] 9–99 (1948) *In German.*—Most of this review is evoted to an account of the application of mathe-atical statistics to problems in geophysics, where xperiment is only possible on a limited scale. bjects discussed include terrestrial magnetism and mospheric tides. L. S. G.

550.34

580. Seismic experiments on the North German xplosions, 1946 to 1947. WILLMORE, P. L. *Philos. rans. A* (*No.* 843) 123–51 (*Aug.* 11, 1949).—Seismic aves produced by explosions near Soltau were bserved at distances up to 50 km, and others from the Heligoland explosion from 50 to 1 000 km. Special time signals and a high recording speed enabled the instant of a sharp onset to be determined to 0·1 sec. Short-range seismic data were used to eliminate some of the effect of rocks near the surface. The average velocity of the first arrivals was 4·4 km/s between 4 and 24 km from the shot point, 5·95 km/s between 24 and 120 km, and 8·18 km/s beyond 120 km. Significant local variations were found at the shorter distances. Alternative hypotheses covering the distribution of velocity in the upper layers gave estimates of 27·4 and 29·6 km for the depth of the ultrabasic layer. Later arrivals proved difficult to identify, and a statistical method was used to estimate the significance of travel-time curves drawn through selected groups of onsets. This test showed that P^* was not significantly recorded, but a number

of onsets at 7 or 8 sec after P_n probably represented a wave travelling for most of its path in the ultra-basic layer and reflected at the critical angle between that layer and the surface. The test failed to decide whether the onsets close to the expected times of P_g should be treated as one or more phases. Confused motion persisted during the period when transverse waves were expected, but, with the possible exception of S_n, there was no significant concentration of observations about lines representing recognized phases. The thermal energy of the Heligoland explosion was $1{\cdot}3\times10^{20}$ ergs, and the energy in the seismic waves was of the order of 10^{17} ergs. The efficiency was therefore comparable with that of a surface explosion, and measurements of the crater confirmed that the rock which covered the charge could not have had much effect on the momentum entering the ground. A.

550.34

6581. On the increase of the period of seismic waves. HARDTWIG, E. *Geofis. Pura Appl.*, **13,** 75–87 (*Sept.–Oct.*, 1948) *In German.*—A theoretical examination of the observational result that with increased epicentral distance for all seismic waves the periods increase and the amplitudes decrease, with the smoothed waves finally assuming sine-character. Previous theoretical difficulties are suggested to be due to the particular way in which certain of the differential equations are integrated, but also to the fact that the earth had not been considered from the point of visco-elasticity. A combination of both causes is indicated as most probable. A. B.

550.34

6582. The analysis of strong-motion earthquake records with electric analog computor. HOUSNER, G. W. AND MCCANN, G. D. *Bull. Seism. Soc. Amer.*, **34,** 47–56 (*March*, 1949).—A single-degree-of-freedom and a 4-degree-of-freedom system, each with viscous damping, are subjected to vibrations by electric analogue methods. The vibrations correspond to the waveform of a particular earthquake record. Typical computer solutions (taken from the oscillograph) are given. For each natural period of vibration investigated the damping required to reduce the max. displacement to $\frac{1}{2}$ the max. undamped displacement was determined. A particular earthquake component required $\sim 20\%$ of critical damping to achieve this. A. J. K.

550.341

6583. Studies on seismic waves. III. Propagation of elastic waves in the neighbourhood of a free boundary. FU, C. Y. *Geophysics*, **12,** 57–71 (*Jan.*, 1947).—Continuous and spherical harmonic waves are generated at an internal point of the medium. By use of the classical method of Sommerfeld, the different modes of propagation near a free surface after the arrival of the waves are examined. From the approximate evaluations of the integrals, it is found that in addition to the ordinary types of body and surface waves, there are also inhomogeneous waves and surface waves which are not of the Rayleigh type. The amplitude factors of these latter waves vary inversely as the square instead of as the square root of the epicentral distance. Altogether, there are not less than five different types of waves and they a obtained from integrations in the neighbourhood the singularities of the integrals.

550.3

6584. Dispersion of longitudinal earthquake wave ALTENBURG, K. *Experientia*, **5** (*No.* 2) 68 (1949) *German.*—Observations with the Wiechert seismo graph of the Geophysical Institute at Leipzig indica the presence of anomalous absorption of longitudin seismic waves, which can be interpreted using t results of ultrasonic research. Travel-time tables f waves of 0·5–3 sec period show, for epicentr distances up to 8 500 km, differences up to 15 se which increase beyond 10 000 km (up to abo 60 sec at 16 000 km). For the intermediate range t author questions the reliability and accuracy of t existing travel-time curves. A.

550.3

6585. Magnetic polarization of sedimentary roc and the earth's magnetic history. TORRESON, O. W MURPHY, T. AND GRAHAM, J. W. *J. Geophys. Re* **54,** 111–29 (*June*, 1949).—Magnetic polarizatio measurements were made on 99 samples of flat-lyin undisturbed sedimentary rocks collected at 8 sites the U.S.A. The majority of samples ranged in a from Pliocene to Eocene, being thus from 5 10 million to 50 or 60 million years old. A fe samples were obtained from Jurassic formatio 125 to 150 million years old. The direction polarization in the plane of bedding, or declinatio was found in $\frac{2}{3}$ of the samples to fall in a narrow ran centring on geographic rather than present ge magnetic north. Present geomagnetic north at t 8 sites ranges from 13° to 22° E. of geographic nort The dip or inclination of polarization in $\frac{2}{3}$ of t samples falls in a small range centring on 63°, whi compares closely with the value of 69° for the avera inclination of the earth's present field at the sit sampled. The results, though few, are consiste with the idea that for 50 million years or so t polarity of the earth's magnetic field has been t same as now and the magnetic axis has had an avera orientation that coincides with the earth's geograph axis.

550.3

6586. The stability and significance of magnetism sedimentary rocks. GRAHAM, J. W. *J. Geophy Res.*, **54,** 131–67 (*June*, 1949).—This study w undertaken to investigate whether sedimentary roc can retain directions of magnetization through lo intervals of geologic time. The method of investig tion is to observe the angular relations of the directio of residual magnetization to the bedding in deform structures, or in beds that were laid down in a rando manner. Systematic relationships found indicate th the direction of magnetization in certain selecte sedimentary rocks remains unchanged for at lea 200 million years.

550.3

6587. On the variation, during a solar cycle, of t period and amplitude of the recurrence tendency magnetic storms. THELLIER, E. AND THELLIER, *C.R. Acad. Sci., Paris*, **228,** 701–3 (*Feb.* 21, 1949) *French.*—Previous statistical investigations of t

riation of the 27-day recurrence tendency have luded storms with sudden commencements; these ould be excluded since they do not generally recur. 3 storms with gradual commencements are here ouped according as they occurred during the phases (i) increasing, (ii) max., (iii) decreasing activity of solar cycle. Corresponding recurrence curves obtained by averaging the magnetic character ures from 90 days before to 90 after the storm. e graphs indicate a recurrence period of 27·0 days ring the max. and decreasing phases, and 27·5 ring the increasing phase, but the latter is not well fined. A distinct increase in the recurrence ten- ncy is found during the period of decreasing tivity. Similar results found from analyses using storms are therefore not due entirely (though ey are partially) to the different distributions of agnetic storms with and without sudden com- encements during the solar cycle. A. T. P.

550.837 : 624.131

88. Geoelectric prospecting with direct and nearly rect current in civil engineering. BOLLO, M. F. *v. Obras Públ.*, **97**, 1–7 (*Jan.*, 1949) *In Spanish.*— etallic and electrolytic conductivity of subsoils is iefly discussed and some indicative examples are ven. Photographs of two instruments for electric ospecting are shown and 4 examples of application subsoil investigation are described. J. A. W.

550.93

89. Comparison of age with the relative abundance argon and potassium in rocks. FARRAR, R. L., JR. ND CADY, G. H. Note in *J. Amer. Chem. Soc.*, **71**, 2–3 (*Feb.*, 1949).—Decay of K^{40} by *K*-electron pture produces A. The A/K ratio in rocks might erefore provide a measurement of their age. periments on 7 rock samples showed no regular crease in A/K ratio with age, apparently because me source of A other than K^{40} was present. The chnique used is summarized and the results bulated. B. C. B.

550.93 : 539.155.2

90. Age determination by radiocarbon content: orld-wide assay of natural radiocarbon. LIBBY, W. F., NDERSON, E. C. AND ARNOLD, J. R. *Science*, **109**, 7–8 (*March* 4, 1949).—Samples of C from woods om many parts of the world showed a constant sintegration rate of $12·5 \pm 0·2$ cpm/g due to C^{14} ntent. Seashell samples from Florida gave $1·1 \pm 0·3$ and Antarctic seal oil $10·4 \pm 0·7$. The tivity measured in wood samples from Egyptian mbs 4 600 years old agreed with that expected from e ½-life of C^{14}. B. R.

551.1

91. The large-scale fields of the earth's crust nsidered as Bénard-turbulence cells. SCHWINNER, R. *B. Öst. Akad. Wiss., Abt. IIa*, **156** (*Nos* 7–8) 441–55 948) *In German.*—Wasiutinski's recent "Studies in ydrodynamics and structure of stars and planets" *strophysica Norwegica*, **4** (1946)] have revived énard's researches [*Ann. Chim. Phys.* (*Ser.* 7) **23** 901)] which are now applied to large-scale cos- ological and geological phenomena. Surface nfigurations are tentatively traced to such systems of convective currents, and an original tectonic pattern is designed as the basis of the later complex developments on the earth's crust. A. B.

551.11 : 525.14

On the geometric and static oblateness of the earth derived from the periodic terms of the moon's motion. *See Abstr.* 5921

551.46

6592. A new development in ocean wave research. SEIWELL, H. R. AND WADSWORTH, G. P. *Science*, **109**, 271–4 (*March* 18, 1949).—A discussion of the advantages of correlogram analysis as compared with periodogram analysis, illustrated by application to a series of oceanic wave observations. N. L. J.

ATMOSPHERE . METEOROLOGY 551.5

551.501 : 621.396.91

6593. Radar and the weather. SATOW, P. G. *J. Inst. Navig.*, **1**, 219–40 (*July*, 1948).—Pt I considers variations in the apparent performance of marine navigational radar in its use for detecting shipping and land targets. The effects of changes in the density of the lower layers of the atmosphere on radar transmissions, their distortion of radar coverage for better or for worse, and resultant errors in the evaluation of echoes are examined. Pt II describes the way in which weather echoes may influence and restrict radar-assisted navigation. The attenuation of field strength with various types and intensities of precipitation, and the effects of these factors on the navigational and collision-warning uses of radar are examined. The detection, tracking and application of weather echoes as an aid to short-range weather forecasting are also covered. A.

551.510.4

6594. Proposals for unification of principal terms in research on atmospheric ozone. PENNDORF, R. *J. Geophys. Res.*, **54**, 169–76 (*June*, 1949).—Definitions and symbols as well as constants are proposed for the use of atmospheric ozone research. A.

551.510.42

6595. Dust—an active meteorological factor in the atmosphere of Northern Africa. EL-FANDY, M. G. *J. Appl. Phys.*, **20**, 660–6 (*July*, 1949).

551.510.535

6596. Seasonal variation of world-wide *F*2 ionization for noon and midnight hours. LUNG, H. L. *J. Geophys. Res.*, **54**, 177–80 (*June*, 1949).—From a study of *F*2 ionization for each month during the two years 1946 and 1947, it is found that for the noon hours there is a definite dip at the geomagnetic equator with a maximum on each side similar to the curves published by Appleton and Liang for the equinoctial months. Further, there is an indication of a second maximum at about 50° geomagnetic latitude. The midnight curves show only one maximum, which closely follows the solar declination. It is suggested that the midnight ionization provides a better criterion for the study of *F*2 seasonal variation than noon-hour values. A.

551.510.535

6597. Theory of lunar effects and midday decrease in *F*2 ion-density at Huancayo, Peru. McNish, A. G. and Gautier, T. N. *J. Geophys. Res.*, **54**, 181–5 (*June*, 1949).—It is shown that the diurnal variation of the earth's magnetic field gives rise to forced diffusion of ions in the *F*2 region. Calculations indicate that at Huancayo, Peru, this diffusion may account for the midday decrease in *F*2 critical frequency observed there. To test this theory, the *F*2 data from Huancayo were examined to determine if, when the solar and lunar magnetic diurnal variations are in phase, the midday values of *F*2 critical frequency are lower than when the variations are out of phase, as called for by the theory. The predicted effect was verified by the observations. A.

551.510.535

6598. The vertical distribution of atomic oxygen in the upper atmosphere. Penndorf, R. *J. Geophys. Res.*, **54**, 7–38 (*March*, 1949).—From consideration of atomic recombination by 3-body collision, the rate of change of O atoms in the lower ionosphere, by day and by night, has been derived. Calculations have been made using different effective radiation temps. (between 5 000° and 6 000°K), solar zenith distances and rate-constants of the 3-body collision. It is concluded that the transition layer, $O_2 \rightarrow O$, is ~ 10 km thick, with a mean height between 100 and 110 km, i.e. definitely below *E*-layer. At night, concentration of atomic 0 is nearly constant, and is negligible above 120 km. Night recombination has no marked influence on the vertical distribution of atomic O. D. R. B.

551.510.535

6599. Correlation of sporadic *E* region ionization over short distances and comparison with magnetic disturbances. Gerard, V. B. *N.Z. J. Sci. Tech. B*, **30**, 27–37 (*April*, 1949).—By means of simultaneous observations of *Es* ionization at several points separated by distances up to 40 km, some new evidence of the horizontal distribution of *Es* ionization has been found. An approximately linear relation between correlation coefficient, based on these simultaneous observations of *fEs* at different points, and distance has been found. This applies over short distances < 50 km. The derivation of a rough empirical formula to calculate permissible frequencies for short distance *Es* transmission has been attempted. The formula necessitates a knowledge of *fEs* at the transmitting location and is very restricted in its application. Indication of moving sporadic *E*-clouds is given, together with the order of the velocity and diameter of one such cloud. Observations of the horizontal component (*H*) of the earth's magnetic field permitted simultaneous comparisons of *Es* ionization with magnetic disturbances. There was no evidence to show any changes in *H* as great as 10^{-4} gauss for any of the observed sporadic *E* ionization. A.

551.510.535 : 538.566.3

6600. Some important effects in the geometrical optic of the ionosphere. Rawer, K. *Rev. Sci., Paris*, **86**, 481–5 (*May–June*, 1948) *In French.*—The results of calculations in ionospheric focusing effects in oblique incidence transmission are presented graphical form. A parabolic vertical distribution electron density with height is assumed. Bri comment is made on the method of Appleto Beynon [Abstr 2284 (1940)] for calculating obliq incidence trajectories. W. J. G.

551.510.535 : 621.396.

6601. Longitude effect in region *F*2 and ionospher forecasting. Oboril, F. and Rawer, K. *C.R. Aca Sci., Paris*, **228**, 1962–3 (*June* 20, 1949) *In French.* The present scheme of dividing the world into zon for the purposes of critical frequency charts is di cussed in the light of geomagnetic knowledge and a adjustment of the zone boundaries is proposed. W. J. G.

551.510.535 : 621.396.11 : 621.396.

6602. A simple Kerr modulator for ionospher recording. Rydbeck, O. *Trans. Chalmers Un Tech. Gothenburg* (*No.* 44) 3–13 (1945) *In English.* Constructional details and auxiliary circuits, togeth with sample records obtained with the device, a given. W. J. G. B.

551.5

6603. On the thermodynamic efficiency of atm spheric circulations. Ertel, H. and Köhler, *Geofis. Pura Appl.*, **13**, 102–8 (*Sept.–Oct.*, 1948) *German.*—Using the standard hydrodynamical equ tions the so-called hydro-thermodynamical ener equation is obtained. From this it is derived th the thermodynamic efficiency, μ, of a steady atm spheric circulation within a closed stream surface is given by $\mu = \frac{Ls}{4\pi(q+)m} \cdot \frac{S}{M}$ where *M* denotes t entire mass of the circulation, *Ls* the average of t non-reversible work (ergs/cm² . sec) done by t circulation on the surroundings at the surface *S* a $(q+)m$ the average of the heat-source strengt (ergs/g . sec) referred to the whole mass *M*. T comparison of spatially different but energetical similar circulations with the same value of the fracti $Ls/(q+)m$ therefore shows that the efficiency mu decrease with increasing linear dimensions in a directions, since in this case the mass *M* increas more rapidly than the stream surface *S*. R. S.

551.513

6604. Large-scale vertical motion in the atm sphere. *Nature, Lond.*, **163**, 495–6 (*March* 26, 1949). Report of a discussion meeting. Bannon described method of estimating up-currents, which can applied to steadily rising currents over a wide are from the rate of rainfall depending upon the approx mate equality of the rate of release of precipitati from a mass of rising air and the rate at which th saturation vapour content of the same air decreas as the temperature falls due to adiabatic expansio Sawyer described two methods to deduce vertic atmospheric movement (*a*) from temperature chang observed when using a network of upper-air observ tions of temperature and wind at regular interval (*b*) from the relation between vertical motion and th divergence of the horizontal wind field, and betwe the latter and the rate of change of the vertic component of vorticity. The former is a quick metho

at the latter is more laborious, although it can be sed when wind observations are lacking. Sheppard escribed another method based on a determination f the horizontal divergence at 100 mb intervals etween 900 and 200 mb, and from this the vertical notion at each level was derived. Miles emphasized e limitations of Sawyer's first method. Sutcliffe ggested that Sheppard's method should be used to etermine the basic facts of the structure and working f typical weather situations in the British Isles where e network of observations is closest and apply them o other parts of the world where upper-air observa- ons are scanty. R. S. R.

551.515

6605. On the energy in a hurricane. LONGLEY, . W. *Bull. Amer. Met. Soc.*, **30**, 194–5 (*May*, 949).—Comparison is made between the energy eleased by an atomic bomb and that available when ater vapour in the atmosphere condenses to water fficient to produce 1 in rainfall over a square mile. umerical calculation shows that the latter is about ouble the former. On this basis it appears that the nergy released by the condensation of water vapour n the hurricane which passed over Florida on eptember 20–23, 1948, was at the rate of 2½ atomic ombs a second. It is reckoned that only a small raction of this energy is represented by the kinetic nergy of the wind, the rest going to heat the tmosphere. A. E. M. G.

551.521 : 539.185

6606. Meteorological effects of solar neutrons. ACAZE, J. *C.R. Acad. Sci., Paris*, **223**, 819–21 *Nov.* 13, 1946) *In French.*

551.521.1 : 523.72

Graphical calculation of solar radiation. *See Abstr.* 890

551.521.13

607. The measurement of the sun's radiation and e solar constant. WEGENER, K. *J. Geophys. Res.*, 4, 53–6 (*March*, 1949) *In German.*—It is emphasized hat if the measuring part of the instrument is placed n a cavity, and then a small cover opened to the sun, ne only measures the difference between the radiation f the cover and that of the sun; the latter would only e measured if the temp. of the instrument were bsolute zero. The various methods in use are riticized. A. B.

551.521.3 : 535.43

608. Scattered and rescattered sunlight. HAMMAD, . *J. Opt. Soc. Amer.*, **39**, 157–67 (*Feb.*, 1949).— pproximate formulae are obtained for the integrals volved in the Hammad–Chapman theory. The rmulae are applicable at all solar altitudes and over wide range of wavelengths ($\lambda \geqslant 3\,000$ Å). An error f $< 1\%$ is claimed. H. H. HOP.

551.578.4

609. Production of ice-crystal clouds by seeding. RASER, D. Letter in *Nature, Lond.*, **164**, 179–80 *July* 30, 1949).—The results of experiments on seed- g carried out under conditions when the atmosphere as supersaturated with respect to ice but not with espect to water are discussed. The type of crystal rmed has been compared with that formed under atural conditions. Also tests have been made on the rate of seeding, the size of the "dry ice" granules and other seeding variables. A. E. M. G.

551.578.4

6610. Formation of frozen rain-drops and the condition of ice-crusted trees. KOTARO HONDA. Letter in *Nature, Lond.*, **164**, 180 (*July* 30, 1949).—The author applies his theory of transformation stress to the case of finely suspended water drops with the central portions unfrozen. He finds that the observed value of the temp. depression is in good agreement with the theoretical value, while the estimated value of the internal pressure is such as to account for the liquid centre. Similarly in the central portions of tree branches water remains as such at low temps. and hence can be transferred from roots to branches in the normal way. A. E. M. G.

551.593

6611. A photoelectric method of measuring the atmospheric attenuation of brightness contrast along a horizontal path for the visible region of the spectrum. COLEMAN, H. S., MORRIS, F. J., ROSENBERGER, H. E. AND WALKER, M. J. *J. Opt. Soc. Amer.*, **39**, 515–21 (*July*, 1949).—The method consists of the measurement of the apparent brightness of "black" and "white" test objects ("targets") located at different distances from a photoelectric telephotometer. Seven pairs of "black" and "white" targets are used. These are rectangular in shape and subtend practically the same angle with respect to the telephotometer. The targets range in size from $0{\cdot}65 \times 1{\cdot}30$ ft to 33×66 ft. The location of the target range provides a means of making atmospheric attenuation measurements for different azimuth angles between the path of observation and the position of the sun. In addition, the location is such that fogs and dust haze occur fairly frequently as well as a highly clear atmosphere. The data obtained during the first year of operation indicate that, for "white light," the brightness contrast is exponentially attenuated and that the attenuation coeff. is surprisingly insensitive to the naturally occurring local variations in illumination along the observation path. A.

551.593.5

6612. The measurement of atmospheric scattering and solar radiation by means of the Arcetri "photocyanometer." FRACASTORO, M. G. AND RIGHINI, G. *Mem. Soc. Astr. Ital.*, **19** (*No.* 3) 209–24 (1948) *In Italian.*—Measurements of atmospheric scattering and solar radiation were made at various places during the summer of 1947 by means of the photocyanometer in order to find a high altitude station suitable for the observation of the solar corona and to determine the absorption coeff. of the atmosphere at these places. The localities chosen were Mt. Majori (1 561 m), Mt. Livrio (3 174 m), Pic du Midi de Bigorre (2 877 m) and Arcetri (190 m). A. C. C.

551.593.5

6613. Measurement of atmospheric light-scattering and solar radiation. FRACASTORO, M. G. *Mem. Soc. Astr. Ital.*, **20** (*No.* 2) 123–9 (1949) *In Italian.*—The photocyanometer described in *Mem. Soc. Astr. Ital.*, **19**, 113 (1948) has been improved by the addition of a diaphragm placed immediately in front of the photocell, and a second and similar diaphragm placed at a

convenient depth in the tube so as to limit the area of the sky to be explored; a third sliding diaphragm allows one to measure either the radiation of the light around the sun or that coming from the sun without disturbing the cell from its position. Observations made with the new instrument from February to August, 1948, are compared with those taken with the earlier instrument. This is part of a programme of work of the Arcetri Observatory to determine the most suitable locations for the observation of the corona without eclipses. V. C. A. F.

551.593.5

6614. The height to upper-atmosphere emissions. ROACH, F. E. AND BARBIER, D. *Publ. Astr. Soc. Pacific*, **61**, 88–91 (*April*, 1949).—Light is passed alternately (with 4-second period) through each of two interference-type filters with different wavelength-bandpass, on to a photomultiplier tube. The photometer is mounted to sweep the entire sky in 32 minutes, and continuous comparison of the background at 5 210 Å and either the 5 577 (O I) or 5 890 + 5 896 (Na I) night-sky lines taken. The variations of intensity are compared with the theory of Van Rhijn [*Publ. Astr. Lab. Groningen* (*No.* 31) (1921)]; the sky is found to be highly non-uniform from the point of view of this theory, believed due to variations in the intrinsic thickness of the emitting layer. It is found possible to choose, for any set of observations, an azimuth such that the emitting thickness from horizon to zenith appears constant; Van Rhijn's theory then gives, from 3 nights of observation, 5 577 (O I), 100 km ± 50 km, and 5 893 (Na I) 280 km ± 50 km. M. W. O.

551.593.5

6615. Sodium in the upper atmosphere. BARBIER, D. AND ROACH, F. E. *Publ. Astr. Soc. Pacific*, **61**, 91–2 (*April*, 1949).—Abrupt changes are found in the intensity of night-sky emission in the region 5 893 Å near the western horizon after twilight and near the eastern horizon before dawn, as measured with the photometer described by the authors (preceding Abstr.). On the assumption of solar-excited resonance, the number of Na atoms N in a column of unit cross-section above a height h is found in the form $\log N = 7{\cdot}97$ for $h = 190$ km to $\log N = 7{\cdot}34$ for $h = 660$ km. The number of transitions per sec per atom is calculated to be of the order of unity. M. W. O.

551.594.12

6616. Ionic equilibrium in the lower atmosphere. BRICARD, J. *J. Geophys. Res.*, **54**, 39–52 (*March*, 1949) *In French.*—An expression is obtained for the intensity of ionization in the lower atmosphere in terms of ionic diffusion coeffs., mobilities, etc. The consequences of the analysis in relation to ionic equilibrium in the lower atmosphere are discussed. W. J. G. B.

551.594.21

6617. The free electrical charge on thunderstorm rain and its relation to droplet size. GUNN, R. *J. Geophys. Res.*, **54**, 57–63 (*March*, 1949).—By means of a novel piece of apparatus, which is briefly described, simultaneous measurements are made of the free electrical charge and the mass of individua large rain-drops falling from thunderclouds. Value obtained in 3 storms are plotted and a definit tendency is found to exist for the charge to increas with the size of the drop. The average free charge found to be 0·015 e.s.u. for a positive drop an 0·019 e.s.u. for a negative drop. Frequent change are found to occur in the polarity of falling drop such that after 2 drops of one polarity have falle there exists a high probability for the next drop t have opposite polarity. R. H. C

551.594.5 : 521.

6618. Application of the methods of celestia mechanics to Störmer's problem. LEMAÎTRE, G. *Ann Soc. Sci. Brux.*, **63** (*Sér.* 1) 83–97 (*June*, 1949) *French.*—Considers the motion of a charged particl in the field of a magnetic dipole, the Hamiltonia being expanded as a trigonometric series as i celestial mechanics. The period of oscillation abou plane motion corresponds to that of mean longitud in astronomical applications of the method. R. A. N

551.594.

6619. The altitude of the layers emitting the light o the night sky in tropical regions, and its variation durin the night. VASSY, A., ABADIE, P. AND VASSY, E *C.R. Acad. Sci., Paris*, **228**, 592–3 (*Feb.* 14, 1949) *French.*—Photometric observations at a N tropica station (Dec., 1948–Jan., 1949) of the night-sky ligh received at different zenith distances yield a singl height estimate for the luminescent layer responsibl for the green (5 577 Å) radiation, viz. 750–1 000 km a the beginning of the night, and 300–500 km befor dawn. For the red radiation at 6 300 Å, correspondin values are 1 000–1 200 km and 450–600 km. Th results are contrary to those found in mid-latitudes for which it is necessary to postulate the existence o more than one layer. D. R. B

551.59

6620. Abnormal audibility zones in long distanc propagation through the atmosphere. COX, E. F *J. Acoust. Soc. Amer.*, **21**, 6–16 (*Jan.*, 1949).—A analysis of microbarograph recordings of air pressur perturbations created by the detonation of 5 000 ton of high explosives on Heligoland, April 18, 194 The instruments responded to frequencies of 0·05 5 c/s. Upper atmosphere temps. were calculate from the arrival times of abnormal signals at statio beyond 220 km, from high altitude meteorologica data and assuming negligible winds above 30 km Temps. agree with N.A.C.A. values up to 42 km, bu show a reduced gradient above that altitude, and max. value of 294°K in the temp. hump from 3 70 km. This temp. max. establishes a critical ra which is refracted to infinity. A new explanation fo observed outer boundaries of abnormal zones therefore proposed and substantiated by recorde evidence of dispersion near the temp. max. A. C.

551.596

6621. The audibility of thunder. FLEAGLE, R. G *J. Acoust. Soc. Amer.*, **21**, 411–12 (*July*, 1949).—Th relatively short range of audibility of thunder explained by use of the observed vertical distributio of temp. and wind velocity in the neighbourhood o thunderstorms.

BIOLOGY 57/59

578

622. Physical apparatus and other aids of physics in biological and medical research. DÄNZER, H., LUTH, H., RAJEWSKY, B., MEYER, A. E. H., SEITZ, O., GAEBELER, J. AND DREBLOW, W. *FIAT Rev. German Sci.* (1939–46) "*Biophysics, II*" [*Off. Mil. Govt. Germany*] 283–345 (1948) *In German.*—High tension apparatus, which has been developed, is described. The betatron has been used as a ray-source for biophysical purposes. Gas discharge and other lamp source for rays and a new type of black-body which can be raised to temperatures of 2 500°K are reported. Developments in microscopic, spectrographic, photographic and similar apparatus are reviewed. Particle counters have been applied to biophysical measurements. W. A. R.

578 : 615

623. Physical methods in biological and medical research. SCHUBERT, G., PIEKARSKI, G., FRIEDRICH-FREKSA, H., RÜHL-STANISLAUS, M., KREBS, A., SCHWAN, H., DANNENBERG, H., POHLMANN, R. AND INTZELMANN, U. *FIAT Rev. German Sci.* (1939–46) "*Biophysics, II*" [*Off. Mil. Govt. Germany*] 162–282 (1948) *In German.*—Gives an account of: the use of artificial radioactive isotopes as tracer elements, the distribution of natural radioactive elements in the body and their use, applications of the electron microscope and fluorescent microscopy. It is shown that blood-counts can be determined from the dependence of electrical conductivity on erythrocyte concentration, and apparatus for sedimentation investigations is described. The absorption and fluorescent spectra of important biological substances are discussed. Apparatus for therapeutic use of ultrasonics and its application, including dosage, is reviewed. W. A. R.

578.088 : 537.533

624. On the influence of slow cathode rays on unicellular organisms. HARDUNG, V. AND MOOS, W. *Experientia*, **5** (*No.* 4) 155–7 (1949) *In German.*—On the action of low velocity cathode rays on microbes and spores of fungi, it has been deduced from ionization data, that the percentage inactivation shows a maximum in the vicinity of 4 kV when the irradiated cell is spherical with a dia. of 0·5 mμ. This result is in fair agreement with the experimental results obtained on *Bac. pyocyaneus* [Abstr. 3036 (1945)]. The 50% inactivation dose, however, has the value of $\sim 8 \times 10^7$ r compared with ~ 100 r obtained with soft X-rays at 3–4 kV. It is considered that the activation of the water plays an important part in the action of X-rays on tissue [Abstr. 1423 (1946)], but dessication occurs under the action of cathode rays. T. A. C.

578.088.5

625. Analysis of microcomposition of biological tissue by means of induced radioactivity. TOBIAS, C. A. AND DUNN, R. W. *Science*, **109**, 109–13 (*Feb.* 4, 1949).—A sensitive quantitative method of analysis of biological tissues is described. Small traces of elements in these tissues are detected by measurements of the radioactivity induced in the material by exposure to nuclear particles, especially in a pile or a cyclotron. For a large number of elements exposure to the thermal neutrons in a chain reacting pile makes this a very sensitive detection technique. By the same method of analysis the distribution and metabolism of elements introduced into an organism may be investigated, with some advantages compared to ordinary radioactive tracer techniques. An example of the use of this method of "activation analysis" is given. H. M.

591.181

6626. Electrical currents in the living body. SHAEFER, H., WENDT, L., GRAF, H. and PÄTZOLD, J. *FIAT Rev. German Sci.* (1939–46) "*Biophysics II*" [*Off. Mil. Govt. Germany*] 63–122 (1948) *In German.*—Deals with the fatal effects of electric currents which at low frequencies are due to heart failure, whilst the action at higher frequencies is still obscure, and outlines recent theories on the origin of bioelectrical potential, discusses the linear-electrocardiogram and the interpretation of electrocardiograms and vector-diagrams. The theory of electrical stimulation is also discussed, and new instruments for producing electrical convulsions and their applications are described. W. A. R.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.84

6627. Biophysics of sense perception. AUTRUM, H., TEUCHER, R., SCHAEFER, H., SCHRAUB, A., FRIEDRICH, W. AND JORDAN, P. *FIAT Rev. German Sci.* (1939–46) "*Biophysics, II*" [*Off. Mil. Govt. Germany*] 124–61 (1948) *In German.*—Deals with threshold values, the sensitiveness of the eye in the visible, ultrared and ultraviolet, colour vision and Schaefer and Schraub's apparatus for measuring threshold sensitivity over the whole spectrum. W. A. R.

612.84

6628. Studies in the physiological mechanisms of vision. PIRENNE, M. H. *Research, Lond.*, **2**, 259–66 (*June*, 1949).—This review introduces the physicist to threshold phenomena and trigger mechanisms, and covers the author's published work on quantum fluctuation as revealed at the threshold of scotopic vision. Figures and a bibliography of the most recent work are given. R. A. W.

612.84

6629. The determination of the spectral sensitivities of the retinal mechanisms by sensory methods. STILES, W. S. *Ned. T. Natuurkde.*, **15**, 125–46 (*June*, 1949) *In English.*—The sensory methods yielding information about the spectral sensitivities of the retinal mechanisms fall broadly into two categories, threshold and matching methods. By examining the application of these methods to the rod or scotopic mechanism of the retina, the operation of several factors—pig-

mentation of the retina and ocular media, intrusion of other mechanisms, etc.—of which account must be taken is made clear. Recent determinations of the spectral sensitivity of the rods are compared. In the more difficult problem of the spectral sensitivities of the cone mechanisms, the classical colour-matching approach has been supplemented by the binocular-matching and the two-colour threshold technique. The ideas underlying these techniques are discussed and some of the results obtained are considered. A.

612.84

6630. On visual acuity in fluorescent and incandescent light. BAUMGARDT, E. *C.R. Acad. Sci., Paris*, **228**, 1795–7 (*June* 20, 1949) *In French.*—The visual acuity of 13 subjects with normal colour vision has been studied with the Landolt ring test illuminated with either incandescent or fluorescent light. To achieve the same acuity the luminance of the fluorescent was 1·22× that of the incandescent light. If the violet, blue and blue-green radiations were removed from the fluorescent light, visual acuity was slightly improved. L. C. T.

612.843.31

6631. System in color preferences. GUILFORD, J. P. *J. Soc. Mot. Pict. Engrs*, **52**, 197–210 (*Feb.*, 1949).—Describes an experimental study of colour preferences, expressed separately by men and women. Differences of hue, chroma (or saturation) and tint (or brightness) were investigated and a considerable measure of agreement was found. The results are expressed in the form of isohedon (equal preference) charts for each colour and it is concluded that a prediction of the average affective value of a particular colour can be made from a knowledge of its Munsell specification. J. W. T. W.

612.843.31

6632. The apparent colors of surfaces of small subtense—a preliminary report. MIDDLETON, W. E. K. AND HOLMES, M. C. *J. Opt. Soc. Amer.*, **39**, 582–92 (*July*, 1949).

612.843.6

6633. Some variables influencing vernier acuity. I. Illumination and exposure time. II. Wave-length of illumination. BAKER, K. E. *J. Opt. Soc. Amer.*, **39**, 567–76 (*July*, 1949).—Functions relating vernier acuity to illumination have been obtained for 2 different exposure times and at 3 regions of the visible spectrum. An apparatus providing the necessary stimulus controls has been described in detail and the procedure is fully explained. A.

612.843.6 : 628.9

6634. Effects of illumination level on visual performance and fatigue. SIMONSON, E. AND BROZEK, J. *J. Opt. Soc. Amer.*, **38**, 384–97 (*April*, 1948).—Six illumination levels (2, 5, 15, 50, 100 and 300 foot-candles) were studied in repeated experiments in 6 normal subjects. The work task involved recognition of fine details (letters) and reproduced the essential features of a conveyor inspection operation. In addition to the studying of various criteria of work performance and their change in the course of 2 hours of work, a large battery of visual tests was applied before and after the work so as to characterize the degree of fatigue. Varied illumination affected the performance more than the functional criteria of fatigue. Only one function, the recognition time for stimuli of threshold size, showed a decreasing degree of fatigue up to 300 ft-c, all other variables, including performance, which changed with a changing level of illumination showed an optimum at 100 ft-c. The demonstration of an optimum level of illumination makes highly questionable the current practice of recommending "minimum" levels of illumination for industrial jobs, since deterioration of performance and increase in fatigue may result when the optimum level is exceeded.

612.843.6 : 628

6635. Accuracy of measurement as dependent on illumination intensity. ERÄMETSÄ, O. *Kraft och Ljus* (*No.* 4) 82–8 (1949) *In Swedish.*—After showing that the Weber–Fechner law leads to the absurdity that perception of contrast is independent of the illumination, a set of 2 formal equations is constructed, one of which expresses the perception intensity as an exponential function of the amount of light reaching the eye, $y = a[1 - \exp(-ax)]$, and the other puts the min. perception of contrast $\Delta P = \Delta y$. The theory is applied to colorimetry and special cases of large contrasts and "grey harmony" with 3 colours are discussed. J. A. W.

612.85 : 534.7

A study of the mechanism of the middle ear. *See Abstr.* 6051

615 : 57

Physical methods in biological and medical research. *See Abstr.* 6623

615.84

6636. Biological and therapeutical effects of high frequency electrical fields. SCHWAN, N., PÄTZOLD, J. SCHAEFER, H. AND STACHOWIACK, R. *FIAT Rev. German Sci.* (1939–46) "*Biophysics, II*" [*Off. Mil. Govt. Germany*] 2–62 (1948) *In German.*—The heating of cell complexes by using several beams of very short waves (multiple field therapy) has possibilities of selective action. The measurement of the dielectric constant and conductivity of tissues is discussed. The employment of h.f. electrical fields has led to the investigation of the heat distribution in tissues and the measurement of the field distribution. Work on the relation between structure and electrical properties in tissues (e.g. liver), in suspensions and other "mixed bodies" has been investigated. The use of probes and special troughs show the effect of laminated structure and the nature of high frequency condenser flux. New methods are summarized, depending (*a*) on resonance, (*b*) on voltage distribution to find the dielectric properties of biological material in the decimeter-wave region. W. A.

615.84

6637. Clinical radiation dosage. COHEN, L. *Brit. J. Radiol.*, **22**, 160–3 (*March*, 1949).—A unit of radiation dosage (the rec or röntgen equivalent clinical) is described, which is applicable to clinical work. The effects of ion-density, field size and overall time of irradiation are calculated so that biologically equivalent doses can be given under all treatment conditions. Tumour lethal doses and tissue tolerance

ressed in this unit are valid for all treatment ditions. H. M.

615.849

8. A radon purification apparatus. SUTTON, C. *Brit. J. Radiol.*, **22**, 164–8 (*March*, 1949).— apparatus is described in which physical means used for the purification. Some modifications of ign are made compared to other radon plants and h respect to yield, purity and radiation exposure, apparatus compares favourably with other plants. H. MI.

615.849

9. Techniques for application of the betatron to lical therapy [with report of one case]. QUASTLER, ADAMS, G. D., ALMY, G. M., DANCOFF, S. M., NSON, A. O., KERST, D. W., KOCH, H. W., NZL, L. H., LAUGHLIN, J. S., RIESEN, D. E., BINSON, C. S., JR., AUSTIN, V. T., KERLEY, T. G., NZL, E. F., MCCLURE, G. Y., THOMPSON, E. A. SKAGGS, L. S. *Amer. J. Roentgenol. Radium r.*, **61**, 591–625 (*May*, 1949).—The 22 MeV atron of the University of Illinois [see Abstr. 1257 49)] has been used to treat a patient with glio- stoma with 20 MeV X-rays. A practical unit of e proposed was the r.e.b.a. (roentgen equivalent bio-assay) obtained by multiplying the reading h a 25 r Victoreen thimble chamber in the betatron m by the factor 0·75, which permitted a prediction the biological effects in the light of experience with kV X-rays. Depth dose distributions are given 3 dimensions. The collimator consisted of Pb inations insulated from one another to reduce ly currents. Isodose surfaces were shaped by a npensating filter of graphite and the resulting sage rate was about 30 r/min. The output was nitored by the positron activity induced in Zn in reaction $Zn^{64}(\gamma, n)Zn^{63}$ which has a threshold at 6 MeV. Since the treatment technique for this t patient involved some 2 000 man hours of velopment work, it is reported in considerable ail which concludes with a tentative evaluation of possibilities of high energy rays in cancer therapy. T. A. C.

615.849 : 537.531

10. A note on back-scatter and depth doses for ngated rectangular X-ray fields. JONES, D. E. A. *J. Radiol.*, **22**, 342–5 (*June*, 1949).—A graphical tem is described of allowing for the effect of ngation of the field on the axial surface and depth ses in deep therapy. Results are summarized in families of graphs calculated for X-ray beams of ality 1–5 mm Cu H.V.L. for elongations 1–10 and as up to 400 cm². The results are checked perimentally. T. A. C.

615.849 : 537.533

11. The synchrotron accelerator—its potentialities a generator of X rays and electrons of 10–50 MeV rgies for medical use. FRY, D. W. *Brit. J. Radiol.*, 462–72 (*Aug.*, 1949).—The principle of the electron chrotron is given, showing its relationship to the atron and the cyclotron. This is followed by a scription of the main characteristics of a β-synchro- n, and the sequence of operations during the celerating cycle, illustrated by reference to the operating characteristics of a 14 MeV and a 30 MeV electron synchrotron. For the latter machine an output of 13 r/min at 1 metre has been obtained. The X-radiation characteristics are outlined, i.e. (1) angular intensity distribution, (2) energy spectrum, (3) mean intensity, (4) output pulse shape; reference being made to the characteristics of betatrons of similar energies. The possibility is discussed of extracting for clinical use the electron beam from a synchrotron. The main factors controlling the engineering design of an electron synchrotron, i.e. size, weight, noise, power consumption, etc., are also discussed briefly. It is pointed out that the main factor controlling the design of both betatrons and synchrotons is the injection process. If an improvement in the efficiency of this (at present $< 10\%$) could be made a major improvement would follow in synchrotrons and betatrons designed for clinical work. A.

615.849 : 537.542

6642. A negative feedback dosage rate meter using a very small ionization chamber. JOHNS, H. E., DARBY, E. K. AND HAMILTON, J. J. S. *Amer. J. Roentgenol. Radium Ther.*, **61**, 550–6 (*April*, 1949).— A d.c. amplifier with electrometer valve input stage and cathode coupled pairs of triodes following is described. Full-scale deflection on a moving coil meter is given by a current of 10^{-14} A and with a chamber of 0·05 cm³ air volume the instrument measures dosage rates down to 5 r/min. Mains supplies stabilized to 1 mV are used and zero drift is about 2% per hour. F. T. F.

615.849 : 539.167

6643. Some recent applications of radioactive isotopes in medicine. WOOD, R. G. *J. Sci. Instrum. Phys. Ind.*, **26**, 249–53 (*July*, 1949).—A review of the last 3 years' development. Many new and useful diagnostic applications of tracer elements have been made, but in the therapeutic field it is confirmed that the value of radioactive isotopes for internal irradiation of tissues is limited, until some method is discovered of effectively concentrating them in the region desired. An account is given of dosage, the use of P and I in diagnosis and therapy, diagnostic application of radio-sodium, the combined use of Fe^{55} and Fe^{59} as tracers in research on blood storage and of autoradiography. Contains 78 references. T. A. C.

616–001 : 534.321.9

6644. The effect of ultrasonic waves on serum proteins. LEPESCHKIN, W. W. *J. Phys. Coll. Chem.*, **53**, 335–43 (*March*, 1949).—Ultrasonic waves increase the average molecular weight of serum proteins if the serum is alkaline and the exposure short. A longer exposure decreases the molecular weight. If the serum is acid, only a decrease in molecular weight occurs. W. A. R.

616–07 : 621.389

6645. Locating gallstones. WALKER, E. A., THURSTON, E. G. AND KIRBY, C. K. *Electronics*, **22**, 92–3 (*March*, 1949).—A chuck for holding a standard Bakes dilator is screwed into a housing and attached at the back to a stack of 14 Glenite ceramic elements

[Abstr. 4771 (1949)], soldered together in series. A co-axial cable, connected to the stack, passes out at the back of the housing to a 4-stage amplifier of 100 db gain and thence to a loudspeaker. The detector probe, on striking or scraping against a stone, transmits a mechanical shock to the crystal elements, thereby giving rise to a piezo-electric effect which is in turn passed to the amplifier, producing a click or scratch in the loudspeaker. By contrast, movement of the probe against soft tissue results in a hissing sound only. H. G. M. S.

616–073.75 : 621.386.14

6646. A transportable X-ray apparatus for mass chest survey. Di Giovanni, H. J., Kes, W. and Lowitzsch, K. *Philips Tech. Rev.*, **10**, 105–13 (*Oct.*, 1948).—A transportable apparatus for mass chest survey by fluorograms of groups of industrial workers, schoolchildren and others, is described. The pictures are recorded on 70 mm film by a Fairchild camera with automatic film strip advance after ever exposure, allowing 375 pictures to be made in un interrupted succession. Constant average density all pictures is achieved by the application of th photoelectric Morgan–Hodges timer, which aut matically terminates the exposure when the film ha received enough light from the fluorescent scree The apparatus also contains a series of other erro precluding devices, such as an interlocking mechanis actuated by the examinee's identification card, whic serves to avoid a possible mix-up of the fluorogram The weight of the total installation, based on maximum X-ray tube rating of 100 kV, 200 mA, only 1 212 lb; this is achieved through the extensi use of Mg alloy castings. The apparatus may disassembled in 12 pieces, thus allowing very rap mounting and dismantling at the site of the day assignment. The vertical adjustment of the X-r tube and screen, the control panel, the photoelectr timer, etc., are described.

GLASS . CERAMICS 666

666

6647. Surface tension anomalies in melts containing lead oxide and boron oxide. Carlén, S. *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 85) 1–11 (1949) *In English.*—Babcock's [*J. Amer. Ceram. Soc.*, **23**, 12 (1940)] method is used to measure the temp. variation of the surface tension γ of five $PbO–B_2O_3$ melts whose PbO percentage varied from 76 to 92. With higher percentages (at about 83) the temp. gradient becomes positive. The cause may be the presence of a component tending to lower γ, but decreasing in concentration as the temp. rises. The 92 melt crystallizes on cooling instead of forming glass. Graphs, tables and illustrations are shown. R. A. W.

METALLURGY 669

669

6648. Electron-atom ratios in alloy phases as a monotonic sequence. Bradley, A. J. Letter in *Nature, Lond.*, **163**, 683–4 (*April* 30, 1949).—Phases of Cu–Zn and Cu–Al systems are discussed. The monotonic sequence $(2n - 1)/n$ represents the ratio of the number of free valency electrons to atoms in the Hume–Rothery series. When this ratio agrees with the sequence, n taking values 1 to 7, there is a tendency for alloy phases to occur. The empirical formulae $CuZn_2$ and Cu_3Al (γ-phase) thus require 5/3 ($n = 3$) as the value of this ratio, while the crystal structures Cu_5Zn_8 and Cu_9Al_4 require 21/13, and the upper limiting compositions for these phases require 22/13. The importance of these ratios will be discussed another publication. A. J.

6

6649. Sites for the free valence electrons in metal alloys of the gamma brass type. Bradley, A. *Physica*, **15**, 170–4 (*April*, 1949) *In English.*—T number of available sites for valence electrons γ brass is discussed with reference to the α- a β-phases. It is concluded that in all 3 cases there a two available sites for each free valence electron. A. E. De

6

6650. Microscopic evidence of orderly precipitati in some Fe–Ni–Al alloys. Bradley, A. J. *Physic* **15**, 175–8 (*April*, 1949) *In English.*—A short accou of the behaviour of b.c.c. and f.c.c. FeNiAl allo on slow cooling. The ordered phase is observed separate out as spheres or cubes or as lamin parallel to 100 faces, these units being multiples a mosaic unit of about 0·25 μ. A. E. De

669 : 532.7

6651. Clustering in solid solutions. Smoluchow ski, R. *Physica*, **15**, 179–83 (*April*, 1949) *In English.* Deals with binary solid solutions which can be de cribed in terms of interactions between nearest neig bours but in which the two kinds of atoms ha different effective ionic radii. The deformatio energies associated with clusters of solute atoms different atomic planes are calculated and the b haviour of precipitates in the AgCu system can interpreted in terms of these energies. A. E. De

PHOTOGRAPHY 77

77.023.471

6652. The action of "surface" developer at various depths in the emulsion layer. Burton, P. C. *Photogr. J.*, *B*, **89**, 41–4 (*March–April*, 1949).

771.376.2 : 551.521 : 535.24

6653. Sunlight and skylight as determinants photographic exposure. II. Scene structure, dire tional index, photographic efficiency of dayligh

ety factors, and evaluation of camera exposure. NES, L. A. AND CONDIT, H. R. *J. Opt. Soc. Amer.*, 94–135 (*Feb.*, 1949).

771.44 : 778.37

54. New lighting for high-speed photography. ANT, W. R. *Gen. Elect. Rev.*, **52**, 22–7 (*June*, 49).—Describes the use of a flash discharge lamp ing a flash of 2 μsec duration to the photography moving objects or transient phenomena. Different thods of synchronization are exemplified. The ap and auxiliary apparatus are not described.

J. W. T. W.

771.53

55. Measurement of the granularity of photo-aphic enlargements on plates. DEBOT, R. *Research, nd.*, **2**, 137–43 (*March*, 1949).—Details are given of paratus suitable for the measurement of granularity. anularograms are used, i.e. plate enlargements of original negative; part of the work consisted of a dy of the relations between the granularograms d the original negatives. Details are given of the thod used for obtaining, from the microphoto-tric readings, numbers which express the statistics the density fluctuations. The theoretical relation ween mean square difference in density and spot as is not verified, a proportionality to the fourth ot of the area being observed, rather than the square ot.

A. H.

771.53

56. Theoretical relationships between various tors affecting the granularity of photographic ages. DEBOT, R. Letter in *Research, Lond.*, **2**, 1–2 (*July*, 1949).—Theoretical. Granularity is arded as due to a random function of the distri-tion of the grains in a photographic layer. The an square deviations of either density or trans-rency may be regarded as measures of granularity. e relationships of the various mean square devia-ns are derived; the skewness of the distributions is rmined by considering separately the positive and gative deviations from the mean. Experimental ification will be published in a future article.

W. F. B.

771.53

57. Non-uniform shrinkage of X-ray films. LINEK, M. H. *Rev. Sci. Instrum.*, **20**, 368 (*May*, 49).—Reports an experiment showing that a large inkage (0·4%) occurred where a hole was punched ough the film, and that on either side of the hole re was a region where the film had stretched ghtly, followed in turn by a region of shrinkage.

R. B. S.

771.534.5 : 778.33 : 616–073.75

58. The sensitometry of roentgenographic films d screens. MORGAN, R. H. AND VAN ALLEN, W. W. *diology*, **52**, 832–45 (*June*, 1949).—An X-ray nsitometric laboratory has been established by the S.A. Public Health Service to measure the speed aracteristics of the commercially available films, reens and developing material used in medical radio-aphy. The data are collected by determining under ntrolled conditions the exposures or quantities of rays measured in Roentgen units necessary to tain film densities of 1·0. The speeds of various films and film screen combinations are calculated from the density/exposure ratio, using the following specifications: Exposure time, 1 sec; HVL(Al), 4 mm; temperature of film and film-screen combination, 25°C; temperature of developer 20°C; and continuous agitation under specified conditions. Information on the speed characteristics of films, screens and developers will be published regularly.

R. H. H.

771.535

6659. Latent image distribution as shown by physical development. BERG, W. F. AND FORD, D. G. *Photogr. J., B*, **89**, 31–6 (*March–April*, 1949).—A technique is described by which the distribution of the latent image as between the surface and the interior of the photographic grains may be investigated by a method of physical development. The method was applied to a representative series of commercial photographic materials which had each been exposed to a range of widely different intensities and times. The results obtained agree well with those in earlier work using chemical development. The internal image shows more pronounced reciprocity failure than the surface image, and no failure at high intensities under conditions at which the surface image shows pronounced high-intensity failure. Most of the physically developed latent image is situated on the grain surfaces. It is concluded that both surface and internal latent images consist of specks of metallic Ag.

A.

771.535 : 541.141.1

6660. The quantum yield in the photolysis of silver halides in photographic layers due to the absorption of silver-halides. MEIDINGER, W. *Z. Wiss. Photogr.*, **44** (*Nos* 1–7) 1–43 (1949) *In German.*—The quantum yield, i.e. the number of photolytically formed Ag atoms per absorbed quantum has been determined for 6 very different AgBr- and 1 AgCl-gelatine emulsions. For the measurement of the incident energy a barrier layer cell was used which was calibrated in terms of cal.cm^{-2} by means of a thermopile. The spectral absorption in the emulsions was determined at wavelengths 366, 436, 546, 578 and 700 mμ by absolute measurements of the reflection and transmission using a barrier layer cell and an integrating sphere. The photolytically formed Ag was determined from exposed and fixed emulsions by an electrometric titration method. In the range of exposures applied $0{\cdot}1–1\times10^{15}$ Ag-atoms/cm^2 were obtained, whereas in the normal latent image only $5\times10^{8}–10^{11}$ Ag-atoms/cm^2 are formed. The quantum yield obtained at 100°c at wavelengths 366 and 436 mμ approaches the value of 1·0, using normally digested emulsions containing a halogen acceptor. At 20°c a quantum yield of 0·6 was obtained with the same type of emulsion with acceptor and 0·1 without acceptor. For Lippman emulsions the quantum yield was of the order of 1 000 times greater with acceptor (0·13) than without ($1{\cdot}10^{-4}$). In spite of the increase of quantum yield for emulsions with acceptor, the sensitivity of emulsions of average grain size was not influenced by the presence of halogen acceptors. It is believed that a quantum yield of 0·6, as obtained for emulsions containing an acceptor, also holds within the exposure range for the normal latent image.

R. H. H.

778.3

6661. Temperature shutter for nuclear research emulsions. DILWORTH, C. C. "*Cosmic Radiation.*" *London, Butterworth's Scientific Publications Ltd.; New York, Interscience Publications Inc.* (1949) 157–8.—Quantitative measurements on the effect of reduced temp. on the sensitivity of the emulsion show that it can be used to preserve plates in storage and transport without impairing the sensitivity shown when the temp. is raised for exposure. A.

778.3

6662. A mass-spectrographic method for the production of density-steps on photographic plates using protons of medium velocities. GEERK, J. AND BRIX, P. *Z. Phys.*, **125** (*Nos* 11–12) 767–79 (1949) *In German.*—For the study of the behaviour of photographic emulsions when exposed to low energy ions, density steps are produced on photographic plates using protons of energies between 2–7 keV in a Thomson mass-spectrograph. Exposures are made through a wide slit which is perp. to the deflecting field. The area of the photographic plate is thus exposed to protons of decreasing velocities from one side of the field to the other. The measurement of the distribution of the proton flux across the field and the optimum position of the slit are discussed. Characteristic curves of various types of photographic emulsions have been obtained. R. H. H.

778.3

6663. Influence of *p*H on the treatment of photographic emulsions for nuclear research. PICCIOTTO, E. *C.R. Acad. Sci., Paris*, **228,** 173–4 (*Jan.* 10, 1949) *In French.*—The *p*H value of nuclear research emulsions influences the properties of the gelatin and the efficiency of development. A study of the absorption of various buffer solutions in regard to the weight and volume of the photographic emulsion with increasing *p*H shows a minimum between *p*H of 2–3 and an almost linear increase between *p*H of 6–12. Equilibrium of the *p*H of Ilford C2 emulsion with that of various buffer solutions is formed after 4 hours impregnation for *p*H values between 4–10·5. An increase of *p*H intensifies the action of organic developers. R. H. H.

778.3 : 535.247.4

6664. Exposure meter for precision light dosage. LAUNER, H. F. *Rev. Sci. Instrum.*, **20,** 103–9 (*Feb.*, 1949).—The meter, developed for regulation of carbon-arc light dosage in the standardization of light-sensitive paper, operates when a photoelectric tube charges a capacitor to the firing voltage of a trigger tube controlling a thyratron. The radiant intensity received by the tube is reduced by exposing it to the first reflection from polished glass, a red glass of low transmission to the radiation being chosen to suppress reflection from the second surface. Reproducibility of the meter was found to be better than 0·32% over 2-week test. Results were tested against the reflectance changes of light-sensitive paper under exposures controlled by the instrument, showing it to be suitable for the desired application. The variability of the uranyl oxalate actinometer, tested against the new meter, was found to have a coeff. of variation of 1·4%, i.e. $< \frac{1}{4}$ of the usually accepted figure. Full description and circuit details are given. W. A.

778.3 : 771.535.1 : 539.1

6665. Fading of the latent image in the photograp of α-particle tracks. COPPENS, R. *J. Phys. Radi* (*Sér.* 8) **10,** 11–13 (*Jan.*, 1949) *In French.*—The fad of α-particle tracks directly recorded in "Ilfor B_1 and C_2 plates was investigated as a function time, temperature and humidity. It is shown th the number of tracks still clearly visible when develo ing a certain time after exposure is distributed in ti approximately according to the Gaussian probabil law, the average "life" of a track image and standard deviation varying with keeping conditio but their ratio being a constant characterizing emulsion. Higher temperature and higher humid tend to increase the fading. The average times v from 16·5 days under atmospheric conditions summer to 18·7 minutes at 50°c in air saturated w water. W. F.

778.3 : 771.535.1 : 539.1

6666. The action of borax on the conservation of latent image in the photography of α particle trac COPPENS, R. *J. Phys. Radium* (*Sér.* 8) **10,** 5 (*Feb.*, 1949) *In French.*—Boron-loaded nucl research emulsions (Ilford C2) show less latent ima fading than unloaded emulsions of the same ty Exposures to α-particles of Po using increasing c centrations of borax solutions lead to a minimum latent image fading at a concentration of 10–30 of borax. R. H.

778.3 : 771.535.1 : 539.1

6667. The mechanism of fading of the latent ima produced by charged particles. ALBOUY, G. A FARRAGI, M. *J. Phys. Radium* (*Sér.* 8) **10,** 10 (*April*, 1949) *In French.*—The fading of latent ima produced by the passage of charged particles throu photographic emulsion layers is investigated by method involving the counting of developed gra along the tracks. It is shown that fading is practica eliminated in the absence of oxygen, and that various other factors known to influence fading, su as temperature, humidity, or changes in *p*H introdu by loading the emulsion layers with certain chemic merely vary the oxidizing reaction. Fading va exponentially with temperature, and its depende on humidity follows closely the swelling of gelat layers. In particular, fading is much accelera above 70% relative humidity. An increase in of the emulsion layer decreases fading, and differen in the behaviour of different types of emuls (Ilford B_1, B_2, C_1, C_2, D_1, E_1) is accounted for by differences. W. F.

77

6668. Calibration of electron-sensitive emulsio ZAJAC, B. AND ROSS, M. A. S. Letter in *Natu Lond.*, **164,** 311–12 (*Aug.* 20, 1949).—The range-ene relationship for electrons in 200 μ thick Kodak N nuclear track emulsions has been extended to energy of 250 keV. Mean values for the total ra of electrons and for the number of grains per tr at a series of energy values are given with the m number of branches per 100 μ length of track. C culated ranges show good agreement with the exp mental values. Details of the calculation of ran based on Bethe's relativity formula for the stopp

ower of H and generalized for heavy stopping atoms e discussed. R. H. H.

778.33

669. **Use of fluorescent intensifying screens in illion-volt radiography.** CORNEY, G. M. *Non-estr. Test.*, **7**, 17–19 (*Winter*, 1948–49).—A comarison between fluorescent screens and Pb foil shows at the former are faster but more grainy with 1 MeV -rays. The increased speed allows the use of in Pb filter between specimen and casette which nproves definition greatly, and the optimum comnation is shown to be such a filter with a non-reen or type K film and a tungstate intensifying reen. F. T. F.

778.33 : 537.531

670. **Possible industrial applications of soft X-radiaon 15–100 kilovolts.** TROUT, E. D., GAGER, R. M. ND PAGE, A. L. *Non-Destr. Test.*, **7**, 20–4 (*Winter*, 948–49).—Comparative tests with a conventional 0–140 kV tube and a tube with Be window working own to 15 kV show advantages in contrast and hortness of exposure in the softer radiation for diographing light castings, plastics and wood. bsorption curves in Al, Mg and Lucite are given well as film blackening for varying exposure. F. T. F.

778.37

671. **High-speed flash-tubes and their applications.** MEADOWCROFT, A. J. *Photogr. J.*, *B*, **89**, 51–3 (*May–June*, 1949).—Construction and method of peration are outlined and the properties related to notographic use reviewed. Tables are shown giving perating characteristics of a range of types and a mber of applications are described in which the ash-tube has found use. [See Abstr. 477 B (1949)]. A.

778.37 : 62

672. **Fast motion picture analysis as an aid to ganized invention.** WATSON, E. M. *J. Soc. Mot. ict. Engrs*, **43**, 289–302 (*Oct.*, 1944).—Describes the various ways of recording the performance of fast-moving mechanisms, and includes a discussion of how to analyse and apply the data to practical development of apparatus. P. A.

771.37 : 621.327.4

6673. **A high-intensity light source for high-speed kinematography.** BEESON, E. J. G. *Photogr. J.*, *B*, **89**, 62–7 (*May–June*, 1949).—Camera operation between 250 and 3 000 frames/sec requires very high light intensities. It has recently been shown that the compact source lamp may be used with very successful results by subjecting the lamp to impulses of current many times above normal for durations of several seconds. Its possibilities are considered and compared with existing known light sources. The lamp is colour-modified and might be applied to high-speed colour photography. A.

778.37 : 621.327.4 : 621.385.1

6674. **High-intensity flash-tubes.** KNOTT, G. *Photogr. J.*, *B*, **89**, 46–50 (*May–June*, 1949).—General purpose flash-tubes suitable for normal photographic subjects are described and a brief description is given of tubes for specialist applications, in particular the "micro-flash" tube, and tubes for stroboscopic applications. A.

778.5 : 621.397.9

6675. **Film recording of television transmissions for the purpose of international program exchanges.** DELBORD, Y. L. *Ann. Télécommun.*, **4**, 190–201 (*June*, 1949) *In French.*—A general survey of known methods of television film transmissions and of tubes suitable for photographic purposes. The intermediate film process, continuous film scanners with double and quadruple exposure and the applications and extensions of these methods to countries with 60 c/s frame frequency are considered and discussed. The author recommends film speeds of 16⅔ pictures/sec for Europe and of 20 pictures/sec for U.S.A. A. L. (R)